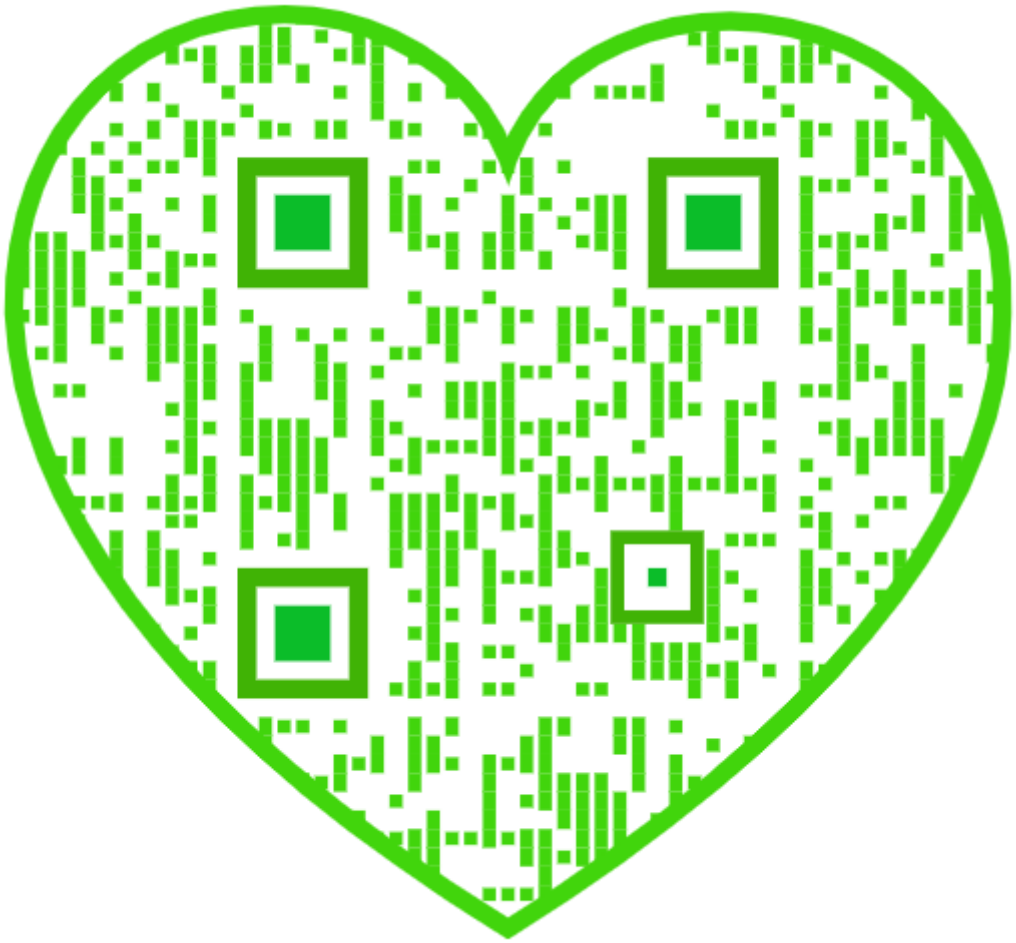

COAL IRON AND WAR

A STUDY IN INDUSTRIALISM PAST AND FUTURE

By

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CONTENTS

PART I

THE GROWTH OF MODERN INDUSTRIALISM

CHAPTER		PAGE
I	The Leadership of England	3
II	The Development of America	17
III	The Growth of Germany	48
IV	The Retardation of France	61
V	The Stirring in the East	68
VI	The Struggle of the Nations	74
VII	The Causes and Effects of Industrialism	87

PART II

THE MATERIAL BASES OF INDUSTRIAL GROWTH

VIII	The Material Bases of Civilization	93
IX	The Coal Resources of the World	99
X	Petroleum, Natural Gas and Water Power	117
XI	Iron Ore Supplies of the World	135
XII	The Supply of the Precious Metals	142
XIII	The Supply of Commercial Metals	153
XIV	Chemical and Structural Materials	177

PART III

THE CAUSES AND EFFECTS OF INDUSTRIAL GROWTH

XV	The Factors of Industrial Evolution	187
XVI	The Progress of Invention and Discovery	201
XVII	The Rise and Fall of Prices	225

CONTENTS

CHAPTER		PAGE
XVIII	The Share of the Worker	244
XIX	The Development of the Corporation	253
XX	Legislative Helps and Hindrances	270

PART IV

THE FUTURE OF INDUSTRIALISM

XXI	The Nature of the Problem	283
XXII	The Progress of Political Beliefs	288
XXIII	The Trend and Rate of Future Growth	305
XXIV	The Factors of World Competition	317
XXV	The Future of World Competition	325
XXVI	Industrialism and War	346
XXVII	The Forms of Future Progress	358
	Index	371

INTRODUCTION

Since our existing differences, both within the nation and between the nations, are based largely upon different interpretations of actual facts, there is always the difficulty that discussion of political, social or industrial movements or conditions may be biassed, in one way or another, by the underlying beliefs of the investigator. This is notably true with regard to current discussions of the growth and status and future of the existing industrial system; for here we meet with very great differences both of interpretation and of opinion.

Among critics of existing conditions — and most of the contributions of to-day are essentially critical — there is a general tendency to start with certain assumptions as to the righteousness or wickedness of private property, of individual capitalism, of protection or free trade, of competition or of government regulation, and of all the other basal factors involved in the matter. Starting in this way, there is in many cases the additional tendency to look upon industrial growth as a matter largely under human and personal control, and hence one which can be praised or blamed from a purely ethical point of view.

As a matter of fact, in dealing with the industrial development of any country, we are considering a phenomenon which is to a very large extent a phase of purely natural evolution; and any discussion which lays undue stress upon either personal or racial factors must be regarded as being historically defective. The results of the broader industrial changes may be good or bad for the community, but they are rarely if ever due to conscious and intentional planning or direction.

On the other hand, we must not fall into the opposite error, and reason that because a thing exists to-day, it is therefore necessarily just and wise or necessarily fixed and unchangeable. If there is evolution, there will be change; and since we are dealing with industrial and social, rather than with purely physical evolution, the change is to some extent capable of human control and guidance. It is not necessary to assume that our existing type of machine civilization is the best possible type; it is not even necessary to assume that it is a really good type. Those are matters for individual opinion and decision. But it *is* absolutely necessary to realize that, whatever its merits or defects, it has come about in a very natural manner; and that there are some purely physical factors which will serve to limit the amount of change that human will can introduce.

In the present volume an attempt will be made to reverse the ordinary order of discussion, by outlining first the history of the industrial development of the leading nations, from the beginnings of modern industrialism until the close of the World War. In tracing out the main stages of this development, stress will be laid chiefly upon the growth of the coal and iron industries, not merely because of their basal character and importance, but because such limitation will aid in giving definiteness to the study. On the other hand by tracing industrial growth abroad as well as at home, we are freed from the danger of local bias, which has too often affected discussion of the development of our modern industrial system.

In the course of this historical sketch, it will be found that at intervals we meet with factors, some physical and some human, which seem to have affected industrial growth in different countries and at different times. Some of these factors have apparently caused or incited growth; others have changed its rate, or altered its direction, or limited its

extent. It will be profitable to study these factors separately, in the light of the facts that have been brought out during the preceding historical discussion.

Finally, having thus treated of industrialism as it has actually developed, and of the factors which have permitted or influenced it, there remain to be considered the effects which the system itself has produced on the community. Here we reach consideration of how it has affected political and social developments as between citizens, in the nation itself, and of what its future trend appears to be in these lines. But we also are forced to consider how it has affected relations between the nations as units, and how future social and international relations are likely to be affected by what we now know of the uneven manner in which the material resources on which industrialism rests are distributed over the earth.

PART I

THE GROWTH OF MODERN INDUSTRIALISM

CHAPTER I

THE LEADERSHIP OF ENGLAND

In following out the growth of modern industrialism, it is necessary of course to commence with its development in Great Britain, where its effects were shown first and most strikingly. The very suddenness and completeness of the change, in fact, creates difficulty in appreciating its extent, for the industrial leadership which England then established lasted so long, and was so preëminent, that it is hard to realize a time when conditions were very different. But in order to get a proper background for this sudden development we have to go back to a time, not so far distant it will be found, when Great Britain was not a country of great importance either in shipping or in manufactures. This was the case during all the early centuries of her history, and though England had shared in the great expansion of trade brought about by the discovery of America, her share for a long time was small compared to that of Spain and Holland.

Even as late as the middle of the eighteenth century, England's industrial future was by no means certain or assured. The manufacture of woolen goods, taken up much later than in France and Germany, had at length been brought to a point of importance, and the time had definitely gone by when all of England's exports consisted of raw materials, such as tin, lead and wool. But the iron industry had not secured a firm foothold, and at the time we note, it had in common with some other industries, reached a point of extreme depression. The English iron output had, in fact, declined steadily for several decades, and to anyone studying the matter in 1750, it would doubtless have been a

very fair conclusion to assume that in a few more decades the British iron industry would be entirely extinct, and that the future iron supply of the world would be secured from Sweden and Russia, and perhaps the American Colonies, all of which then equaled or surpassed Great Britain in iron output.

If the investigator of 1750 had been warned that, during the sixty years which were to follow, England would fight practically all of Europe, not once but in three successive and long wars, and that the more important of the American colonies would be lost early in these struggles, his ideas as to the future industrial and political standing of Great Britain might have been even more pessimistic. There was apparently nothing on the industrial horizon to offer hope for the British iron industry in particular, and yet it was on the verge of such an expansion as the world had never seen before in connection with any industry in any land. Furthermore, this great expansion was to come not only in this one great basal industry, but it was to spread out, enlarging and remodeling the entire industrial structure of the country, and to ultimately bring about great social and political changes.

Before the dawn. It will be advisable to get some idea of the general industrial situation in England, and for that matter elsewhere, just before the beginning of the period of rapid expansion in manufactures. It must therefore be recalled that at the date which has been selected for convenience as marking the approximate ending of the old and beginning of the newer type of industrialism, most industries were still of the household or neighborhood type, carried on by individuals, by families, or by very small groups of employed workers. The power available for manufactures was merely manual, except that in favored localities a small water power development was in use. The steam engine — of modern type — did not exist, though a few engines of the Newcomen type were in use for pumping out coal mines at

least. Transportation of commodities was not a matter of prime importance, for when production was on such a very small scale, the commodity could in general be made close to its market. If there had been any need for transportation, there were of course no railroads, there were no canals, and the common roads were very bad indeed. Coal was used chiefly as a domestic heat producer, and since there were no adequate means for unwatering the coal mines, both its consumption and its production were limited.

Under these conditions the result was a small-scale and widely scattered production of most manufactured commodieties. There was no way under which large accumulations of capital could be profitably applied to industry under such conditions; and even if the way had been open, there were few large individual or corporate accumulations of capital to be so used. Finally, and this is the point in which we are at present most interested, there was no indication that these conditions would not persist for a long time to come; there was no intimation that within a half-century this type of British industry was to be swept away as completely as had been the ancient civilizations of the East. In 1750 as in the hundreds of years preceding, politicians talked of ancient prerogatives or of ancient rights; jurists bowed before ancient law; philosophers dreamed of ancient free states: and all the while the thing that really mattered was unheralded and unnoted — the fact that a new industrialism was beginning to take shape — an industrialism which would eventually shatter all these ancient privileges and dreams and theories against the hard facts of modern life.

The awakening in England. It has been said that the appearance of the new type of industrialism was sudden — and in truth its most striking manifestations were grouped together within a few decades, though their effects have lasted until the present day. Between 1760 and 1810 the organization of British industry was changed throughout, and the bulk of the changes were at least commenced during

the first three decades of that period. During that brief space of time came a series of remarkable improvements in spinning and weaving machinery, which would make it both possible and profitable for the textile industries to group workmen in factories or other large operating units if the necessary power could be secured. And, as if in prompt response to this demand, came the modern steam engine to furnish the power. The steam engine furnished power not only to the manufacturer, but it enabled economic pumping, deepening and hoisting at the coal and iron-ore mines, so that the fuel and ore required by the new industrialism could be provided cheaply and in ample quantities. And, in turn, the engine required better steel and better shopwork than had been needed previously, both of which requirements were met by inventions and improvements. Finally, the grouping of the industries in large units having now become feasible and economically necessary, the transportation of both the raw materials and the product of these large units became a matter of serious importance. So we have the beginning of highway and canal development, and a very little later the commencement of steam navigation and of railroads.

On examining this remarkable series of changes in industrial processes and organization, it will be seen that they acted and reacted on one another in very complicated fashion; and their grouping in point of time was so close that it is difficult, in many cases, to say which of two changes was the cause and which the effect. Some of the questions which arise in that connection will be discussed later, in taking up consideration of the conditions which favor invention and industrial change. But at present we are concerned more directly with the fact that the new organization of transport and industry which was brought about by all these changes had two very distinct though related effects, not only upon the coal and iron trades, but upon most other manufacturing industries. From this time on there were much larger

and wider markets for manufactured products and for raw materials, so that tonnages or quantities produced could be greatly increased: and it would also be physically possible and economically necessary to produce these increased tonnages in larger and more closely grouped plants. The day of the small forge and furnace and mill had passed away; the day of the small individual proprietor, too was passing. From that day on to the present the trend of development in these two regards has never changed; and the huge industrial plants and organizations of to-day are but logical and necessary results of the changes which took place in British industry over a century ago.

The extent to which the various industries have been developed in different countries has of course been determined, to a very large extent, by the natural and other resources of those countries, a matter which will be discussed in detail in a later section. The form which the developing industrial organization has taken also has natural causes, but in this case there have been local modifications due chiefly to differences in the legal and political theories current at different times and in different places. These phases of the subject will also be taken up separately later. At present attention will be directed solely toward the purely external and quantitative effects which were brought about.

The extent of British development. In order to follow out the new development clearly, and to avoid being lost in a maze of statistics and dates, it will be well to limit attention to the growth of the British iron and steel industry, which showed in most typical form the effects of the new impetus which all industries had acquired so suddenly. It will lend definiteness to the discussion if it be so limited, and in case of necessity illustrative data can be drawn from other industries.

Aside from its basal importance, by dealing with this industry there is the further advantage that fairly reliable data are available as to British iron output, even for the

earlier periods, while for later years the figures are very good. All the results which are really necessary for the present discussion are shown graphically in figure 1 on this

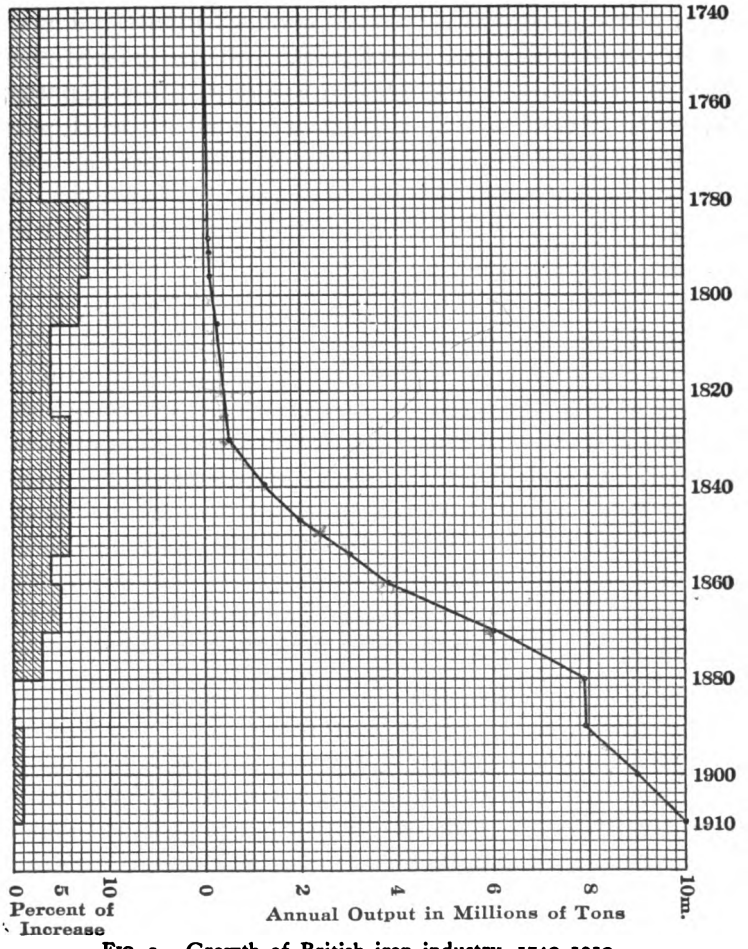

FIG. 1. Growth of British iron industry, 1740–1910

page. In the upper portion of that diagram the British iron output is shown over the period 1740 to 1910. In the lower portion of the figure the average per cent. of annual increase of output for each period is also graphically shown.

On looking over the British iron-production figures we can see that the entire time covered can be divided pretty clearly into four periods, distinguished by quite sharp differences in the annual rate of growth of the industry. Unfortunately there are no yearly statistics for the earlier dates, so that the exact limits of these four periods have to be fixed, in part, by data obtained from study of the industry in competitive countries. The periods in question are as follows:

The growth of markets, 1700 to 1775. During this preparatory period the English iron output as earlier stated showed little or no growth; and over a large portion of the period actually seemed to show a declining tendency. The annual rate of growth from 1700 to 1775 was, so far as can be determined, less than one per cent. This rate was far lower than anything which followed for the next hundred years, and it is not until 1890 that English iron growth again fell as low. We have no good population figures prior to 1800, but it seems certain that during this first period the amount of iron produced in England actually showed a decreasing number of pounds per year per capita. At the close of the period the population of Great Britain was probably in the neighborhood of eight million. The annual output of pig iron therefor amounted to perhaps three to five pounds for each person. What this means in the way of general use of iron can only be comprehended if we recall that in the years immediately preceding the World War, the outputs of America, Germany and Great Britain ranged from five hundred to one thousand pounds per capita each year. Later, in discussing the colonial iron trade in America, we will get some idea of the extremely limited uses to which iron was put in those early days.

During this preparatory period the growth of manufactures was not, indeed, very marked in any line, but the forces which were later to incite rapid development were already at work. In studying English history of the later seven-

teenth and most of the eighteenth centuries, our attention is ordinarily drawn toward the political and military struggles of the time, so that we note the gradual increase of freedom in British political institutions, and the equally gradual increase in the British prestige abroad, without paying much attention to the commercial and industrial effects which were being incidentally produced. As a matter of fact the outstanding feature of the period, looked at from our present standpoint, was the growth of the British colonial empire, and the development of British trading enterprise, so that access was given to vastly broader markets than had been hitherto possible. The British merchant fleet and the British navy had at last become of the first importance, in sharp contrast to the preceding centuries, when other fleets and other navies had held higher rank.

By the end of the period we have selected as that of preparation, Great Britain had broadened her overseas dominion to include all of America east of the Mississippi, and most of present India, while to these great protected markets are to be added the numerous scattered trading stations and colonies established along the great trade routes. Large and growing overseas markets were now open to the British manufacturer and merchant, access to which was guaranteed by British shipping. In time of peace, there were the colonial markets, restricted to British use alone under the system then in vogue; in time of war all the neutral markets of the world were British, thanks to the navy. Under these conditions there would be obviously future growth of commerce, but there were as yet no reasons for supposing that this could continue indefinitely, or that it could exist except under the conditions of a powerful navy and a colonial trade restricted to the home country. New and favorable factors were to appear in the period which followed.

The Industrial Revolution in England, 1775-1815. The forty years here grouped can be considered as covering the

period of wonderfully rapid development in all industrial lines which is commonly called the Industrial Revolution. The dates of its beginning and ending are naturally indefinite, but for our present purposes 1775 has been selected as marking its beginning, so far as the British iron trade is concerned. That date corresponds closely with the ending of iron imports from the North American colonies (owing to the American Revolution), imports which had up to that date been far heavier than seems to be generally understood. This matter will be recurred to later, in discussing the history of American industrial development. Here it is noted, because it seems certain that in large part the iron which would normally have come from Maryland and Virginia must have been replaced by increased British output.

Of the forty years included in this period, Great Britain was at war for thirty. The almost continuous struggle affected industrial development, but it did not cause it. On the contrary, it may be said that *in spite* of these wars industries were able to develop in Great Britain, thanks to certain special features which in her case limited the evil effects of the conflicts. With the exception of one very brief period in 1781, the British navy held the seas. Behind that shelter crops could be gathered in peace, industries could develop unchecked, and goods could be shipped to the markets of all the world. English contributions in men were not large, and losses were light. At the close of four decades of war Great Britain emerged with a largely increased population, with highly developed industries, and an enormously expanded foreign trade. Most of the American colonies had been lost, but the American trade had been held and even increased.

During those forty years the rate of increase of British iron output averaged about eight per cent. annually. The output had risen, at the close of the period, to over eighty pounds per year per capita. In other lines of manufacture the increase had been almost as great, and much more strik-

ing in some ways, so that in considering this period attention is often concentrated disproportionately on the textile industries, for example. The advances in these latter, however, were effects and not causes of the industrial revolution. That had originated in the forcing effects of ready access to wider markets, and had developed thanks to the coal and iron resources of Great Britain. Comparisons with the condition in other countries at the same period brings out this latter point very clearly, and when we come to consider the growth at various periods of the United States, of Germany and of France we will see the same sequence of phenomena repeated in each case.

Here we may profitably note two points which might otherwise be overlooked, bearing on the form which the new industrialism took and on its geographic localization. With increased access to Asiatic and the growing American markets, there would have been steady increase in commercial and manufacturing growth in any case, but this growth would have been at a rate limited by primitive methods of production and transport. What gave this period its entirely new type of activities was the improvement of the steam engine under Watts and Boulton, which offered an efficient source of power. It could be seen immediately that this new power could be developed in large units, so that a great increase and concentration in manufactures were possible. It would be seen almost as quickly that the new power was not fixed in position, like a water wheel or wind mill, so that soon it was applied to revolutionizing the methods of transport.

The second point relates to the material conditions under which the new power could best be developed — and this could be seen immediately to require access to coal and iron. At the time Great Britain was the most fortunately located of all the nations with respect to these two necessary materials, for the coal fields of the United States were still unknown and those of Germany were far inland. Steam ship-

ping, then as always, fell to the nation which could supply cheap bunker coal; and Great Britain assumed a lead both in manufactures and in commerce which was retained for over a century.

Undisputed world leadership, 1815-1870. During the fifty-five years which followed Waterloo there was great and relatively steady industrial development throughout the world, in which Great Britain took the leading part. There was, at the close of the Napoleonic wars, a decade of serious depression, rarely noted by historians intent only on political events, but clearly enough marked in the industrial progress of the different countries. In discussing the growth of the United States we shall see how very difficult a decade followed the peace. But around 1825 there were compensations for the losses of the wars, and world progress was resumed. The gold supply began to be heavily increased from Russian and Siberian discoveries, the Spanish colonies finally freed took up a new growth, and the United States and Canada spread out far to the westward of their older settled limits. New markets again brought new manufacturing activity.

For the period which followed, Great Britain was the undisputed industrial leader of the world, and her iron and other great industries found at least their share of the market. Cheap bunker coal meant cheap freights, and imported food supplies permitted Great Britain to be turned essentially into one vast workshop. So long as her coal supply was the cheapest and most accessible in the world, there was no reason to fear foreign competition at home, and the freest of free trade was the obvious economic policy for the England of those days. Its advantages were so very obvious, as applied to England, that it began to be considered the only proper and virtuous policy for all nations, and the fact that the United States and France and Germany hesitated to accept this doctrine was long looked upon as merely a sign of their intellectual inferiority.

Later in the period came another great burst of world-wide activity, forced and aided by railway development all over the world and by great gold discoveries in California and Australia. Throughout all of this time there was no war which interfered seriously with the British export trade, and only one in which Great Britain herself was seriously involved. Modern industrialism was in course of development in other countries, it is true, but England's two great future competitors were still far in the rear, so far as world markets were concerned. Increasing imports of food supplies and of raw materials, such as cotton, were more than paid for by increased exports of finished goods and by freights. With regard to the great basal industry, railway development all over the globe brought about heavily increased demand for new types of iron and steel products, and English mills supplied a very large proportion of this demand. With the prompt adoption of the Bessemer steel process, and the growth of the steel ship, British industry and commerce were again favored.

Considered merely quantitatively, the British iron output during the years 1815 to 1870 showed a very large and quite steady rate of increase. It was not so large in percentage, however, as during the period immediately preceding, for we see that it averaged only five per cent. annually in place of the earlier rate of eight per cent. But it was so great that by 1870 the British iron output averaged about five hundred pounds annually, per capita of British population. This was a far cry from the five pounds per capita of the century previous, and represented a great advance both in manufacture and in utilization.

It represented also, though one of that day would not have had any reason to know it, about the high-water mark of British industrial preëminence. For just as in 1770 a new development had come unheralded, at a time of apparent depression, so in 1870 new competition was about to appear, equally without warning, to limit further growth.

The period when one nation supplied the world with practically all manufactured goods was about to pass.

Competition for leadership, 1870-1914. The selection of 1870 as the initial date for the final period — that of open world competition — is entirely arbitrary. What really happened was that at various times, from 1865 to 1878, a series of more or less unrelated events occurred, all of which in the long run served to diminish and finally overcome the immense industrial lead which Great Britain had established during the Napoleonic wars. The more important of these events may be mentioned here, but only briefly, since they will be recurred to later in discussion of American and German industrial growth. In order of time we may therefore call attention to the development, after the American Civil War, of the western United States, the opening of new rich American ore supplies, the relatively permanent adoption by the United States of a high tariff policy, the acquisition by a United Germany of the Lorraine ore fields, and the later discovery of the basic Bessemer process which made those ores valuable, and the final German decision to embark on a policy of protection and intense industrialism. It would be impossible to select any special date, between 1865 and 1878, of the years covered by the events above noted, and say that at this special date England definitely would have to face the future loss of industrial leadership; but it was within this range of years that the foundations were laid for the competition which was ultimately to have that effect. In later chapters we will see what were the conditions, chiefly as to coal and ore supply, which could overcome a lead so long held and so firmly founded.

During the fourth period the output of British iron increased little more than one per cent. a year. In the years just before the Great War the production amounted to about five hundred pounds per capita annually, just about the same as in 1870. Industrial growth, so far as this great

basal industry was concerned, had for over forty years failed to more than barely keep pace with population. Meantime the United States and Germany had both shown far more rapid growth, and in the decade preceding the World War Great Britain had fallen back to third in rank among the iron, steel and coal producing countries of the world.

CHAPTER II

THE DEVELOPMENT OF AMERICA

Having outlined the course which industrial development followed in Great Britain, we may now turn to consideration of the effects shown in the United States during the same periods. It will be found that though the two countries started from almost equally low industrial levels in 1750, and though they were again on equal terms as competitors in the advanced industrialism of 1900, there were many periods during the intervening century and a half in which the course of affairs followed in America was widely different from that of Great Britain. In discussing this history we can again pay chief attention to the growth of the coal and iron industries, as offering the best guidance through a maze of otherwise overwhelming statistics.

The Colonial iron trade, 1619-1783. In most of the colonies which later formed the United States of America, iron making was taken up as one of the earliest of manufacturing activities, preceded in most instances only by the making of brick and tile. In Virginia furnace operations started at least as early as 1619, and by the middle of the seventeenth century Massachusetts, Rhode Island and Connecticut had also commenced production. These early plants were small blast-furnaces or smaller bloomaries, run of course on charcoal as fuel, and fed with bog iron ore except in Virginia, where another type of ore was readily obtainable near the settlements. Though they served useful purposes in the economy of the early settlements, the conditions as to ore supply did not promise any great expansion, and as a matter of fact none of these very early iron enterprises has left a successor in the same locality.

In the first quarter of the eighteenth century, however, a more promising series of developments took place. In Pennsylvania, in New York and in New Jersey iron mining and iron making was now taken up in localities back from the coast, and many of the localities then opened are still ore and metal producers. These newer plants, still run on charcoal as fuel, utilized the brown iron ores associated with limestone in the Kittatinny and Lehigh valleys of New Jersey and Pennsylvania, and the magnetic iron ores which occur so abundantly in the northern part of New Jersey and in the Hudson Highlands. Maryland, too, began operations on a new type of ore, which promised greater permanency of supply than had the bog ores.

It is questionable if in 1700 the entire iron output of all the colonies amounted to over one or two thousand tons annually, and this was entirely employed at home. With the developments in the Middle States, however, this tonnage increased rapidly, and by 1730 it was sufficient to cause anxiety to British iron producers. From this time on we encounter more frequently English petitions for protection against colonial iron imports, and for restrictions on colonial manufacture and trade. American iron exports to Great Britain beginning early in the eighteenth century had actually increased by 1741 to some thirty-five hundred tons per year. This is of course a ridiculously small amount, judged by our present day standards, but it must be remembered that it was about a fifth of the total British output of that day. Its commercial importance can be realized better if we consider that its equivalent to-day would be the annual shipment of three to four million tons of American iron and steel into England.

By the middle of the century, steering a middle course between the home producer and the home consumer, the British government had arrived at a fairly definite policy with regard to colonial manufactures. The colonies were to be encouraged to produce and ship to England such raw or

semi-finished materials as could be raised or made more cheaply in America than elsewhere; but finished manufactures were to be discouraged or prohibited, as tending to spoil a market which had been carefully reserved for the British manufacturer. As applied to the iron industry, this policy permitted the manufacture in the colonies, and the shipment to England, of pig iron and bar iron; for the English domestic supply was, as we have already seen, falling off at this date. Since her requirements had to be met by importation anyway, it was better to import crude iron from her own colonies than to increase her dependence on Sweden and Russia for this important commodity. On the other hand, the fabrication of bar iron into finished products, and the manufacture or fabrication of steel, were to be discouraged or prohibited in the colonies.

Regarding the effects of this colonial policy, we have very exact and ample data concerning one phase, and but little save surmise concerning the other. The prohibitions and regulations against the manufacture of finished products certainly did not kill such manufactures as had started, but they were probably successful in preventing any further growth along these lines. The encouragement given to the colonial shipments of pig iron and bar iron was, on the other hand, very effective; and its effects are clearly shown in the annual customs house returns. The exports of crude iron from the American colonies to England amounted in the years immediately preceding the Revolution to almost nine thousand tons. This was perhaps a third as much as Great Britain was producing at that time.

When we examine the geographical sources of these exports, certain facts of interest appear, for the chief exportations came from rather unexpected sources. It is, of course, not a matter for surprise that the Carolinas figure to only a trifling extent in the export figures, but the small tonnage sent out from New England, New York and New Jersey could hardly have been expected. Pennsylvania

makes a somewhat better showing, reaching almost a thousand tons of pig and bar iron together by 1755; but throughout the whole period the main exports went from Maryland and Virginia. The two colonies together always accounted for well over half of the total exports, and for most years their proportion stood at two-thirds or more of the total.

For all of this colonial period we have no complete data on the total amount of iron produced in American furnaces and forges. But, taking the exports into consideration, along with fragmentary data as to the iron output or iron-making capacity of different colonies in different years, we must rate it at a rather high figure, as iron production went in those days. It seems indeed probable that during the middle of the eighteenth century the American colonies were making almost if not quite as much pig iron, bars and blooms as Great Britain. Perhaps we should be safely within limits if we assume that from 1740 to 1775 the total iron production of the colonies ranged from 15,000 to 25,000 tons annually. This might be from a fifth to a third of the world's total output during the same decades. It would be almost a century before the United States would regain the same relative importance as an iron producer that was held by the colonies in 1750, for at that date the English output had fallen off owing to the increasing scarcity of local charcoal, and there was no serious output from Germany or France. On a charcoal basis, the future of the iron industry seemed to rest between the American colonies and the Baltic countries.

During the Revolution the iron output of the united colonies must have increased quite markedly, for the demand for iron products was heavy, and most of it had to be supplied by colonial furnaces and forges. Fortunately none of the important iron producers were located within the immediate field of military operations; and the output of crude and finished iron and steel in New York, northern New

Jersey, eastern Pennsylvania and eastern Maryland was not interfered with at any time during the struggle. No data are available as to annual output, but taking into account the general conditions it is probably safe to assume that during the years 1775 to 1783 it may have averaged some thirty thousand tons annually. For comparison we may figure the British output, during the same years, as averaging certainly not over forty thousand tons.

In the preceding discussion of the colonial iron trade there has been an intentional suppression of detail, so that attention could be fixed upon the main features of its development, and upon its relation to development elsewhere during the same period. The comparisons induced by consideration of this last phase of the subject are strikingly contradictory of certain very prevalent impressions as to the relative industrial status of the colonies and the new republic. Our study of the iron industry leads us to the conclusion that the colonies, during the decades 1740 to 1780, were a far more important factor in the world's iron industry than was the United States during the first fifty or sixty years of its existence. In this one great basal industry, at least, the United States lost ground steadily as compared with its leading competitor, for many decades. It was not until the Civil War that it produced the same percentage of the world's iron output that it had made at the time of the Revolution.

This apparent anomaly is not noticed if we limit our attention solely to the United States, and pass by what was happening elsewhere in the world. Studied as a purely local matter, the American iron industry has shown a fairly steady growth from small beginnings to first rank among producers. But when we take up a study of the growth of the industry elsewhere during the same period, we see that there was a long time during which England advanced very rapidly indeed, while the American growth was very slow. So that though at the close of the Revolution, England and

America had been of almost equal importance as producers of iron, yet fifty years later England was making six times as much pig iron as the States. It was not until 1890, over a hundred years after the Revolution, that the two countries again reached equality for a moment.

In order to understand how this curious cross-current of growth came into operation, we must recall the conditions which at the close of our Revolution existed in industrial Europe, and the factors which were then bringing about what has been called the Industrial Revolution. We will then see that the independence of the United States came about at a time when industrialism throughout Europe was changing in structure; and that England, best adapted at the moment to these new types of industrial activities, achieved an apparently commanding lead, not only in the iron trade but in all other forms of machine industry.

First fruits of peace. Ever since the surrender of Cornwallis in 1781 it had been obvious that peace and freedom were near at hand. Now, in 1783, the independent colonies were at length able to look about them, and reckon up the costs and the prospects. From either standpoint the view was sufficiently disheartening.

There had, first of all, been an actual loss in population during the struggle. This was not due to chiefly deaths in battle or by disease, but to the emigration of a large section of the loyalists to Nova Scotia and New Brunswick. Contemporary estimates assumed that at the close of the war the colonies contained some 100,000 less people than at its start.

Second, and more immediately disheartening to the American manufacturer, the peace had barely been signed when heavy British shipments began to reach the ports of the new nation. The development which British manufacturing industry had commenced during the last decade or so was now about to show some of the possibilities of the new industrialism. Within the first ten years after the close

of the Revolution, the balance of trade had already swung heavily against the States.

From this table it can be seen that, up to about 1745, the balance of trade had been, as a matter of fact, slightly in favor of the colonies. Even the adverse balance from that date on to 1783 was not, in reality, so unfavorable a

BRITISH-AMERICAN TRADE BALANCE, 1700–1790

AVERAGE FOR YEARS	EXPORTS TO ENGLAND	IMPORTS FROM ENGLAND
1700–1710	£ 265,783	£ 267,205
1710–1720	392,654	365,645
1720–1730	578,831	471,343
1730–1740	670,129	660,137
1740–1750	708,943	812,648
1750–1760	802,691	1,577,420
1760–1770	1,044,592	1,763,410
1770–1780	743,561	1,331,206
1784–1790	949,250	2,491,898

symptom as might appear, for during those thirty-eight years there were three wars, necessitating heavy shipments of supplies to the troops in America; and such shipments probably accounted for most of the excess imports during the decades 1750-1780.

But with the end of the Revolution it can be seen that the character of the trade between the confederated colonies and England had changed very markedly, and that for the worse, so far as America was concerned. A country with little accumulated wealth could not long stand such a drain on her resources as was indicated by the export and import figures during these years.

Finally, there was the knowledge that Britain possessed many marvelous new machines and processes, which must be introduced into American industry if that was to be placed on a competitive basis. This led to attempts to secure plans and recipes from England, in defiance of British prohibitions. To which the mother country responded by remark-

able activity in the way of preventing or remedying such disclosures.

How far these amiable practices were carried on both sides is well brought out in the correspondence [1] between Phineas Bond, the British consul at Philadelphia, and the Marquis of Carmarthen, then head of the Foreign Office. Writing on November 20, 1787, Bond says;

> I have the honor to enclose to your Lordship the affidavit of two persons, natives of England, who with great resolution and no small personal risque purchased here and reshipped to Liverpool three machines for spinning cotton and a machine for carding cotton for spinning. These machines your Lordship will find were clandestinely shipped from Liverpool to Philadelphia, packed in Queens' ware crates and casks to elude discovery. Their utility in the manufacturing of cotton induced these men to endeavor to prevent their being established here, which they effectually accomplished by returning them to the country from whence they were fraudulently exported.

Later in the same letter Bond discusses freely the philosophy which underlay these attempts to stifle the infant manufactures of the new confederation.

> Endeavors have been and certainly will be used, my Lord, to inveigle manufacturers from Great Britain and Ireland, and tho (from the smallness of their capitals) the people here may not be able suddenly to engage in extensive manufactures, the very wants of the country will ere long point to speculations of that sort; and many material articles may gradually advance towards perfection and interfere essentially with the manufactures of Great Britain. . . .
>
> I do not apprehend, my Lord, that any of the manufactures for which premiums are offered will be speedily brought to a State of Rivalry with those of Great Britain, but when matters of this sort are in agitation it is fit to guard against an evil, which, though at present in its infancy, may by perseverance and management progressively arrive at such a pitch as to in-

[1] *Ann. Rep. Amer. Hist. Assoc.* for 1896, pp. 552–554.

terfere essentially with the interests of the British manufacturers.

And later, regarding a point of special interest;

> In like manner, my Lord, the same political event has extinguished the Parliamentary restraint upon slitting mills. Many mills of that description have been erected within a few years to the great profit of the owners. The facility for obtaining bar irons and the great and immediate demand for the larger sort of nails has totally put an end to the importation of the sizes above sixpenny, as they are called; the lesser sort, which requires more labor and more art and are not in so great demand, are still imported from England. The naileries here are not carried on as extensively as they might be. There is a want of hands; parents are averse to placing their children to this sort of trade, and the most liberal offers of schooling, freedom dues and other indulgences have failed to obtain anything like the numbers required.

Before we resume consideration of the quantitative growth of manufactures it may be of interest to consider for a moment the character of the infant iron industry of America at this date, so far as its processes and products and markets were concerned. To do this we must forget everything we know of the present United States, and go back mentally into a world of very different type — different not only in degree but even in kind.

At the close of the American Revolution the new world had still a very small and closely limited use of iron and steel products. There were of course no railways or steamboats anywhere, neither in America nor in Europe. In the colonies, indeed, there were no steam engines whatever, of any type or use. There were few machines of any sort used in any industry, and a maximum of hand labor. Such textile and other manufacturing as was carried on was done on a very small scale, and at widely separated small shops or plants; most of it, indeed, was done in the home. Trans-

portation, whether of manufactured products or other commodities, was effected by pack-horses or by wooden carts or wagons on land; by wooden ships and barges on water.

Under these conditions we can readily understand that certain lines of iron and steel products which we now regard as fundamental either did not exist at all, or were in merely trifling demand. Steel had practically no structural applications; it was used almost exclusively for cutting tools and for instruments. Wrought iron was used in the form of nails, spikes and bars; and in agricultural implements. Cast iron, on the other hand, was used for many purposes to which it is really ill adapted — cannon, for example, were often made by direct casting from the furnace. Stove parts, cooking and other household utensils — these accounted for much of the iron utilized.

The bulk of the American iron output, as marketed in 1783 or later, was therefore cast iron, produced in small charcoal furnaces, making from a few tons up to 25 tons per week. Some of this pig metal was sold in that form; much of it was made directly into castings from the furnace. Of the wrought iron used, a portion was produced direct from the ore in small bloomaries; another portion was reworked from the pig. A very small tonnage of blister steel was made during the Revolution, to fill the urgent necessities of the case; after the war its production almost or quite ceased for some time, though we hear of it again about 1800.

For the best summary of the American industrial situation, during this critical period in our history, recourse must again be had to the renegade American who acted as His Majesty's Consul at Philadelphia. Writing to Lord Carmarthen on November 10th, 1789, Bond says;

> Manufactures which require art, labor and expense to any great extent of either, may be attempted but they will often fail for want of capital and because the extensive capitals in Europe can afford their manufactures at a rate vastly lower

than almost anything can be afforded for which is undertaken here.

Where the raw material however can be taken from the earth and converted into an article of immediate use or speedy demand with little expense and art, and where from the bulk or weight of the foreign manufactures the expense which may attend the carriage is great, the American manufacturers will have the advantage of the European manufacturers, and in this line the Americans do and will succeed.

Under the description of articles of immediate use and speedy demand may be comprehended nails and coarse manufactures of iron, tools which relate to husbandry, to architecture, and which are used by most handycraftsmen. Under the description of articles of heavy bulk or weight may be comprehended anvils, forge hammers, anchors and cast irons of various kinds for mills, carriages, and other purposes.

This was certainly a very clear and fair summary of both the actual situation and the immediate prospects of the American iron industry; but in a schedule accompanying the letter Bond furnished details as to the extent of American industries at that date in the different states. The data furnished, so far as they relate to the iron and steel works, are as follows:

NEW ENGLAND. Shovels, nail rods, nails, iron plates or castings and most of the coarser manufactures of iron are made here.

NEW YORK. The principal manufactures at present are nails, nail rods, bar iron, hollow iron castings and various other iron castings, kettles, pots, stoves, chimney backs, etc.

NEW JERSEY. There are nail manufactories at Burlington and in other parts of this State. One at Burlington has 20 fireplaces; but they are by no means fully employed. The iron furnaces and forges in this state are very profitable. There are in New Jersey a steel works, and a plating forge, several furnaces, bloomaries and fineries, and one air furnace, chiefly employed in casting kettles to make potash and maple sugar. The furnaces in New Jersey

generally manufacture hollow iron castings and coarse castings for the West India market.

PENNSYLVANIA. The manufactures of iron are carried on with great spirit, there are many furnaces, forges and slitting mills extensively and profitably employed. Pigs, coarse castings of various sorts, bar iron, nail rods, and nails of sizes above sixpenny, large flooring brads, deck and sheathing nails, scythes, sickles, shovels, spades, tire for carriages and wheel boxes are manufactured in great quantities; so that the importation of large nails and cast iron is for the most part at an end. Steel is also made here of a better quality than the common English steel — but not equal to Crawlays; the iron of America is well calculated for this species of manufacture which might and probably will be very profitably attended — at present the importation from Europe is reduced about one quarter.

SOUTHERN STATES. The iron of Maryland is of a very good quality; they export vast quantities of it in pigs, but the quantity of bar iron exported is but small in proportion, most of the forges being at a great distance from navigable waters. The coarser kinds of castings are also made at the different furnaces.

Four decades of uncertainty; 1783-1823. For the four decades to come, after the peace with Britain, the progress of the new nation was not the steady triumphal march so often depicted, but a very irregular growth, marked in some industries at least by alternating periods of hope and equal or longer periods of depression. This is well shown by the industry which we have selected as a basis for discussion. For, when all the available data are gathered, we get a very remarkable and unexpected picture of what actually happened in this basal manufacture during the four decades in question.

We find that, popular impression to the contrary notwithstanding, we actually lost ground in this great industry, so that less pig iron was being annually made in the United States forty years after the Revolution than had been made

in the colonies before independence had been accomplished. There had been growth in many other directions, it is true, but there had been lost ground in this. And when comparison is made on a relative basis, the results are still more discouraging, for though in 1770 or 1780 Great Britain and the colonies had been almost on a parity, so far as annual output of pig iron was concerned, in 1820 Great Britain was producing almost half a million tons a year, as compared with some 20,000 tons in the United States. The former equality had changed to a ratio of 25 to 1 against the new nation.

The actual course of industrial events, during this forty year period, may be briefly summarized. Immediately after the peace with England, the feeble American industries were crushed down under the weight of British imports. The rather mildly protective measures adopted in 1792 gave them, however, an opportunity for renewed growth, which was increased in some industries by the later commercial treaties. A commercial depression about 1798 forced output down for a year or two, when growth was resumed. The embargo, silliest of political expedients, wrecked foreign trade but to some extent encouraged the more necessary of the domestic manufactures, and some lines were very rapidly developed under the stimulus of the embargo, the later period of non-intercourse, and the final war with Britain. This was so much the case that, for one example, the iron made in 1814 was estimated currently at between 65,000 and 85,000 tons, or some eight times as much as in the depression following the Revolution. But this favorable state of things could not last. The closing of the European wars brought another deluge of English products on a really very limited American market, and a sharp downward trend of domestic output immediately followed. The unloading of overstocked British mills was followed, with hardly an interval to regain courage, by a serious commercial depression in 1819; and the American iron output in

consequence of these factors pitched steadily downward from its high in 1815 to a very low point indeed in 1820 and the year or so immediately following. Then, however, began a rise which this time was to endure, and that will be discussed later.

The illusion that has thus been dispelled — that of phenomenally rapid and sustained growth from independence onward — is one of merely local interest. But along with it we must note the passing of another widely held belief — that the so-called industrial revolution took place about the same time in all countries and in all industries. We have already seen that this great change was accomplished in England during the Napoleonic wars. But in the United States and, as we will see later, in Germany and France, there was little trace of it during the period in question. It did not affect American industry in any marked degree until after 1823.

During the four decades whose history has just been discussed, there had been little if any advance made in the technology of the American iron industry. Fuel, furnace operation, product and methods of after-treatment were all much the same in 1823 as they had been in 1783.

All the American iron made was charcoal iron, for no serious attempts had as yet been made to substitute coke or anthracite as a fuel. Perhaps four-fifths of the total product was pig metal from blast furnaces, the remainder being iron made direct from the ore in bloomaries. Puddling and rolling had been introduced in 1817, but as yet neither process had been widely adopted, and the typical American product was therefore a hammered bar, as distinct from the puddled and rolled iron so extensively imported from Europe. Finally, such steel as was made was still blister or cementation steel, the crucible process not being introduced until later, a century after its adoption in England.

In considering the industrial history of this period it is well to bear these technical conditions in mind, for they not

only serve to explain the slow development of American production, but they throw some light on the tariff controversies of the time. It was true for example that hammered charcoal iron could be made in the States about as cheaply as anywhere in the world, but for most uses it could not compete with puddled and rolled coke iron.

The Industrial Revolution in America, 1823–1857. The three decades whose industrial history in the United States is now to be considered, saw the same Industrial Revolution in America that had been the notable feature of English history forty years previously. There was the same growth, at almost the same rate, from a commencement in sheer depression. At the close of the period most American industries were firmly established on a large-scale basis, organized along essentially modern lines.

The period commences with the world just emerging from almost a decade of profound industrial and commercial depression, which had succeeded the twenty-five years of world wars in Europe and elsewhere. The war period had been characterized by vast expenses and wild currency inflation everywhere, by the great expansion in output of English mills and factories, and by a forced and unsound growth of local manufacturing industries in the countries which were temporarily debarred from securing British goods. The collapse after the peace was widespread, and even the steadily increasing Russian gold output, which was very large for that period, did not avail to stay the decline. The American iron output, as has been seen, was in 1820 only a quarter of what it had been in 1814, and less than it had been in 1775 or 1783. In this great industry at least, the new republic had not maintained its standing of fifty years before.

As in the case of the English iron industry of 1740, this period of depression and declining output was to be followed by a growth equally remarkable and long sustained. For in 1823 the United States was on the verge of a growth

in the iron industries which would, in three decades or so, increase their annual output forty times over the production of 1820. The Industrial Revolution had at last reached America, forty years after it had given British industrialism its new life.

The rapidity and extent of this growth in iron output, during the period whose industrial history we are about to consider, can be best appreciated when the facts are presented in graphic form, as in Figure 2 herewith.

In order to better understand what this growth meant, relative to the world at large, it will be interesting to draw

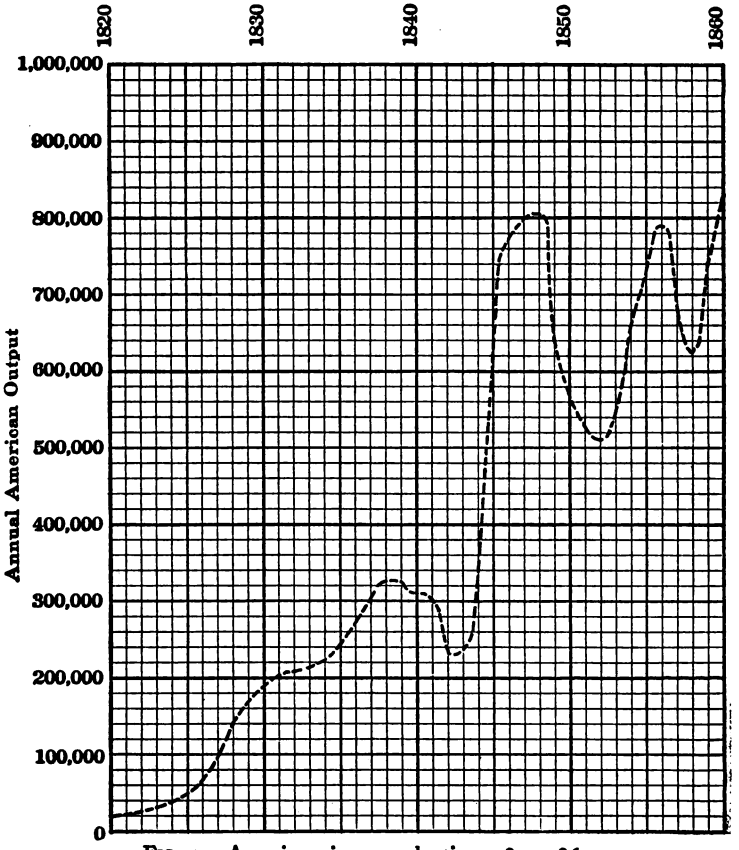

FIG. 2. American iron production, 1820–1860

some comparisons. In 1820, for example, we can assume that the pig-iron production of the entire world did not amount to over 900 thousand tons. Of this 400 thousand was made by Great Britain. France, Russia, Germany and Sweden followed in the order named, but very far below Great Britain, their outputs ranging from 120 down to 50 thousand tons a year. Below them, again, came in turn Belgium, Austria — and finally the United States. At that date the United States was not better than eighth in rank as an iron producer, her output was one-twentieth that of Great Britain, and around one-fifth that of either France, Russia or Germany. And — this is the point of chief interest — in 1820 it was by no means so obvious as in 1920 that this low rank was merely temporary. An observer might have concluded, reasonably enough, that the United States would continue to develop rapidly as an agricultural nation, and would continue to draw the bulk of its manufactured goods from Europe.

One reason for this state of things is not far to seek. It was this — that of the ten millions who inhabited the United States in 1820, there was probably not one person in a thousand who had ever actually seen a piece of American coal, and perhaps not as much as one in ten thousand was mad enough to dream that it would ever be of any service, except as a convenience to the housewife or — as a very wild suggestion — to the blacksmith. It is hard to realize this condition now, when we have come to accept the manufacturing use of American coal as a matter of course. Let us recall merely that all the records available seem to indicate a movement of only a few thousand tons a year from the anthracite regions, chiefly to Philadelphia, and almost entirely for use as household fuel. As for bituminous coal, only the mines of the Richmond district in Virginia had been opened, and they shipped perhaps forty thousand tons a year. To-day, a total coal output of over five hundred million tons furnishes a sharp contrast. In 1820, however,

American coal simply did not exist, as a serious commercial product, though it too was on the verge of taking part in progress. By the end of the period we are now discussing — 1857 — the output of American coal had risen from the few thousands above noted to around twelve millions of tons.

Recurring to the diagram just presented, attention need hardly be called to one of the very striking features in connection with American industrial growth, for it is shown very clearly in the figure. The feature in question is its remarkable irregularity of rate, as compared with similar growth in other industrial countries — Great Britain or Germany for example. When we consider the movement only by decades or by longer periods, the noteworthy matter is the total extent of the progress. But when it is studied in more detail, the outstanding facts are its tremendous rises, and its no less remarkable declines. The American iron industry had already, at this early date, assumed its characteristic feature, that of being "either prince or pauper," and many other American industries have shared its fortunes in this regard. Comparison, over the same periods, with the growth in British or German output is very interesting, and indicates that we are dealing largely with a local and national, not a world-wide, phenomenon.

This irregularity in American development is not chargeable to technical factors, for as regards raw materials we have managed to find new or enlarged supplies about as they were necessary. Neither is it due to periodic losses in population, or to sudden losses of territory — as in the France of 1870. There are, it seems, two factors at work here, both of human origin, which are more active in the United States than in its European competitors. One is the wild expansion, and equally sharp depression, which is a characteristic feature of a new country whose development proceeds more rapidly than its available supply of capital. The other is the unsteadiness of our fiscal policy;

for whatever we may think as to the advisability or error of either free trade or protection, no one can deny that the United States is the only civilized nation which has been subjected to such rapid, sharp and frequent alternations of policy in these regards. The period which we have now under immediate consideration, 1820–1857, throws a good deal of light upon both of these factors, for it includes several great financial crises, and several violent changes in tariff policy.

We are apt to speak casually of the tariff of the United States, without stopping to think that a tariff policy is the one thing we never have had. Since the first discussion in 1789, we have been deluged with argument on both sides of the question, for whenever a political party is utterly at a loss for a platform, it immediately takes up the question of changing the tariff, in one direction or the other. Congressional and cart-tail oratory have never been lacking, while the books, pamphlets, reports and briefs on tariff questions have been one of the main causes for the vast growth in the American paper industry. Under these circumstances it will be realized that, in discussing tariffs in this volume, we are treading on very dangerous ground; and if to that we add a discussion of currency questions, the chance of getting through safely is very small indeed. Nevertheless the two matters must be referred to, since both are notable features of the period under review. We are not, however, interested in theoretical arguments on either subject, but merely desirous of getting some facts into the record, a practice quite foreign to political discussions on such matters.

The period which we are discussing commenced during the great trade depression following the Napoleonic wars, a depression which was world-wide in its effects. The financial crisis of 1819, felt in every country, had remedied the worst of the inflation, both in currency and in business, which had grown up during those twenty-five years of

almost constant warfare. The revival of activity, after this severe crisis, was not immediate, and did not proceed at the same rate in all industries and in all countries. This revival, which can be noted about 1820 to 1825 in almost every country, seems to have had several broad and general causes. There was for example the growth of the American population and its steady extension westward, with concurrent increases in the agricultural and commercial importance of the western regions; there was also development, commercially at least, in the South and central American colonies as they won their freedom from Spanish rule; there was a steady and important increase in gold output, due to discoveries in Russia and Siberia, which aided in reëstablishing sounder finances in the nations of Europe. During the wars, also, England had developed the new machine-industrialism, and that was now spreading quite rapidly to the Continent and to America. Commodities could be produced in quantity under the new system; new markets, as has been noted, were opening for such commodities; and now the means of reaching these markets were in process of great improvement. In 1807 the first commercial steamship had been operated on the Hudson; in 1816 the English Channel was crossed under steam; and in 1819 the Atlantic. Railways, operated under steam, were to appear shortly, the first English line commencing operation in 1825.

Under these stimuli — new markets, new and cheaper ways of reaching them, new and cheaper products,— trade and industry were forced into rapid growth. In the United States these general causes were aided by the operation of tariffs, which certainly accentuated and specialized the growth of American industry, though just as certainly they were not the principal cause of that growth.

The iron industry, as we have seen, had languished until the middle twenties, and it is difficult to credit all its growth after that date to the tariffs of 1824 and 1828, and still to admit that those of 1816 and 1818 had been of no avail

whatever. But when a protective tariff happened to coincide with an outburst of world-wide industrial activity, the cumulative effect was of course tremendous, and we have in consequences a really remarkable growth in American iron output in the years from 1823 onward.

But a policy which had endured from 1816 to 1828 was of course too good to last, so in 1832 there was the beginning of tariff reductions which reached their point of lowest duties about 1842. The action of the iron industry under these various changes is interesting, and might be instructive. From the 20 thousand tons of annual output in 1820, it rose to well over 300 thousand a year in the period 1836–7–8. Then, but not till then, it began a fall which left it with not much over 200 thousand tons a year in 1845. But as to the reason for this fall, we have to seek farther afield than a tariff act.

From about 1820 onward the world had increased industrial activity at a very high rate, and the beginning of railroad development aided in this activity. But it also aided in bringing about its end, for the fixation of capital in enterprises which were not immediately productive, though of course of great future value, led to the collapse. As usual during great trade booms, speculation had been rampant in every line, and in the United States it had been specially dangerous in the form of a western land boom. This, as also is usual, had reached its maximum immediately before the collapse of the whole structure. The additional fact that the banking system then in vogue was hopelessly unsound made the immediate effects more severe in America than in Europe.

Rallying slowly from the effects of the crisis of 1837, the world took on a renewed activity about 1842 or a little later. In the American iron industry the effects were first shown in 1843–44, and the growth then begun carried the output from a low of about 230,000, tons a year up to 800,000 tons in 1848. This rise was of short duration, for

a drop of 500 thousand tons occurred in 1852. Another rally, carrying American iron output in 1856 to the old annual record of 1848, was cut short again by the panic of 1857. Economists generally ascribe the leading part in this world-wide activity of the 1845–1855 decades to the influence exerted by the gold discoveries in California and Australia, but careful examination of our own iron production figures, and of the diagram of average prices, later presented (page 231), seems to throw more than a little doubt on the accuracy of this conclusion. The industrial activity commenced before gold was discovered, it reached its apex about the time of the discoveries, it ended in the usual speculative collapse in spite of the increased gold output. The subject is of great importance and will be later recurred to (Chapter XII). As to the effects of the tariffs of 1842, 1846 and 1857, which happened to coincide with years of change in the direction of world activity, they seem to have accentuated the effects of these general changes. Their direct influence, however, was perhaps less than that of the internal changes which had been produced in American industry along the line of improvements in practice and in product; and to these changes some consideration is now due.

The industrial revolution which came to pass in the United States, like its earlier predecessor in England, not only brought about increased output of commodities, but it was marked by technical progress and by the development of great manufacturing centers. The growth of output has already been referred to and illustrated, but the two other marked features of the new industrialism may be briefly discussed.

As to technical progress during the period 1823–1857, the American iron industry at last adopted several of the great improvements which had been taken up at earlier dates in the English trade. The delay in the adoption is very marked, and casts some doubts on the quick adaptability

which we are accustomed to attribute to the American temperament. It is the more curious, because it will be seen that some of the changes, at least, could have been profitably made long earlier. The following tabular statement summarizes some of the more important changes, made either in the iron industry itself or in the later treatment of its product during the period now under review.

	England	*America*
Coke first used as furnace fuel	1735	1837
Coke generally adopted	1780	1865
Puddling process introduced	1783	1817
Rolls used	1783	1817
Hot blast adopted	1828	1834
Crucible steel made	1740	1832

Of the changes noted, the two which had the broadest industrial importance were the substitution of coke for charcoal as a furnace fuel, and the use of a heated instead of a cold blast in the furnace. The first made possible a great increase in iron output by coal-producing countries, as compared with the limited and ultimately declining output which must be expected from a region where charcoal is the fuel used. It also made sharp changes in the localization of the American iron industries, from the seaboard and Allegheny regions, where the furnaces were mostly located during the charcoal (and the intermediate anthracite) period, to the regions west of the mountains, in the great bituminous coal fields of Pennsylvania, Ohio and West Virginia. The second technical change, the heating of the furnace blast, made a very sharp cut in manufacturing costs at any given works, reducing the cost per ton of pig-metal at least 25 per cent. and often more. This was one of the most suddenly made economies in the history of the industry, its closest rival in this regard being the later invention of the Bessemer process for making steel, which likewise caused a very great reduction in cost of product per ton.

The remaining phase of the matter — the development by the new industrialism of great manufacturing centers, need hardly be discussed at length, for its effects along this line are very generally understood. In connection with our special subject it need only be pointed out that the importance of western Pennsylvania as a manufacturing region dates from about this period. The broadening of the demand for bituminous coal and coke gave to Pittsburgh an additional and greater reason for existence, aside from its advantages for reaching the Mississippi and interior markets which had first attracted industries to the river junction.

War, inflation and collapse; 1857–1873. During the period whose industrial history has just been discussed, the United States had been particularly fortunate as regards serious wars. The war with Mexico had been on a small scale and had no perceptible influence, of itself, on American industry; though at its close we acquired a vast Pacific coast territory which later did have very important effects by aiding finances and inciting railroad development. In the period which we are now to consider, the conditions were in this respect very different, for the outstanding feature of that period was the occurrence of a great war, with its immediate incitement to certain special industries, and its usual effects of inflation and subsequent collapse.

A recovery from the crisis of 1857 would have been in order, but the actual results were given shape entirely by the outbreak of the Civil War. This meant, as usual, a preliminary collapse of industry, followed by a sharp recovery in such lines as furnished military products. The four years of war wrecked the iron industry of the southern states for several decades, while they stimulated iron and steel output in the north to an excessive degree. As the currency depreciated, because of the usual war inflation, prices rose to astounding heights, and business of all sorts reached its usual unsound condition. The end of the war found business and industrial conditions in thoroughly bad shape, north as well

as south. The fact that the customary payment for the military debauch was not exacted immediately, but deferred for almost a decade, was due to certain local factors.

Two chief reasons may be ascribed as causes of the delay in collapse after the Civil War, one involving a factor whose effects already have been noted at other times, and the other showing the first great effects of protection. We were left at the close of the Civil War with very high prices, a vast government debt, heavy taxation, depreciated currency, over-expanded plants and a great labor surplus. Under ordinary conditions these would have implied a long period of heavy imports and of unemployment at home. What seems to have saved the day, after a brief time during which labor surplus caused unrest, was the almost immediate great development of railroad building and settlement in the west. This new market for both labor and materials took the strain, for the time, off the situation. But ordinarily this would have implied, considering relative prices, that foreign goods would have supplied much of the new demand, particularly along the lines of steel products. Here the protective tariff entered very definitely, and so far as we can see, for the first time in American history it was the decisive factor in development. All previous tariffs had been comparatively light and with very little permanence. But during the Civil War the tariffs had been placed at very high figures, partly as compensation for very high internal taxes on business, and they were continued at these high figures for many years, long after the internal taxes had been reduced and abolished.

Under these conditions, of a large new demand and a protected market, the industries of America grew rapidly, in spite of the thoroughly unsound financial conditions which underlay them. It was not until 1873 that the delayed collapse finally appeared so that we had the remarkable phenomenon presented of a country which had been forced to market its six per cent. bonds at 30 (in gold), taking

the lead in extravagance and expansion within a decade.

The period 1857–1873 saw no great American invention in the iron or steel industries, but it did see the adoption in the United States of the two great modern steel-making processes, and the commencement of manufacture in both lines. The Bessemer process had been developed in England about 1855 by Bessemer and Mushet, and reached a commercial stage in that country before 1860. Here it was experimented with shortly after its English success was evident, and Bessemer steel became a commercial commodity toward the close of the Civil War. Open-hearth or Siemens-Martin steel, the invention of Siemens (German) and the Martins (French), worked out in France and England about 1864, was taken up as an American industry in 1868. None of the processes used before 1855 had succeeded in making steel which could be produced in large quantity at any reasonable price, with the result that prior to this time wrought iron was in use for structural railroad and shipbuilding purposes for which we now use steel. The general adoption of the Bessemer process made it possible to broaden the steel market to a very unexpected extent, but these effects were not noticeable during the period now under review, for as late as 1871 the United States produced less than 100 thousand tons of steel of all kinds, as compared with an annual output of almost two million tons of pig iron. A successful war has only a shade less evil effects on technical development than a losing war.

There was, however, one development of great importance to the steel industry which took place during this period, but it was not due to invention. Reference is made to the growth in use of iron ores from the Lake Superior region. The first discovery of ore in that district had been made, it is true, in 1844, and as early as 1850 small test shipments had been made to a Pennsylvania furnace, but shipment on any serious scale was prevented by transportation difficulties. In 1855, however, a ship canal was opened

at Sault Ste. Marie, and in 1857 the Marquette mines were connected with Lake Superior by rail. It was now possible to send ore east in quantity, and the tonnages mined and shipped increased steadily, reaching the million-ton mark in 1873. The ore was a high-grade hematite, carrying close to 60 per cent. iron and very low in phosphorus. It was an ideal ore for the Bessemer process, and goes far toward explaining the rapid growth of that process as the Lake Superior region developed.

So far as quantity of production was concerned, the period here discussed showed remarkable growth. In 1860, the iron output of the United States was a little over 800 thousand tons, while by 1873 it had reached over two and a half million tons. And what was more to the point, though this was a period of world-wide activity, the American output had gained faster than that of its leading rival, for it had more than tripled in the thirteen years, while the British output had not quite doubled. Nevertheless, the close of the period still showed Great Britain with a safe lead, making six and a half million tons of iron as compared with the two and a half made in the States. Germany was still a close third in output, making only a few hundred thousand tons less than America, but the loss of Lorraine had retarded French progress, and her output as fourth was far behind the leaders.

Leadership and world competition, 1873–1910. The United States had arrived by 1873, as has been seen, at a very high level of industrial development, but in the years to come a new rise was to take place from this level, which would place America in the lead among manufacturing nations, and which would furthermore bring it into contact with world competition in neutral markets.

The panic of 1873 and its resulting liquidation brought about widespread financial disaster, but after a brief period of uncertainty the iron and steel industries took up their growth, so far as output was concerned, at the rapid rate

of increase which had become accepted as characteristically American. Railroad expansion was resumed so quickly that the resulting fixation of capital could bring about another crisis as early as 1884. Other industries were showing

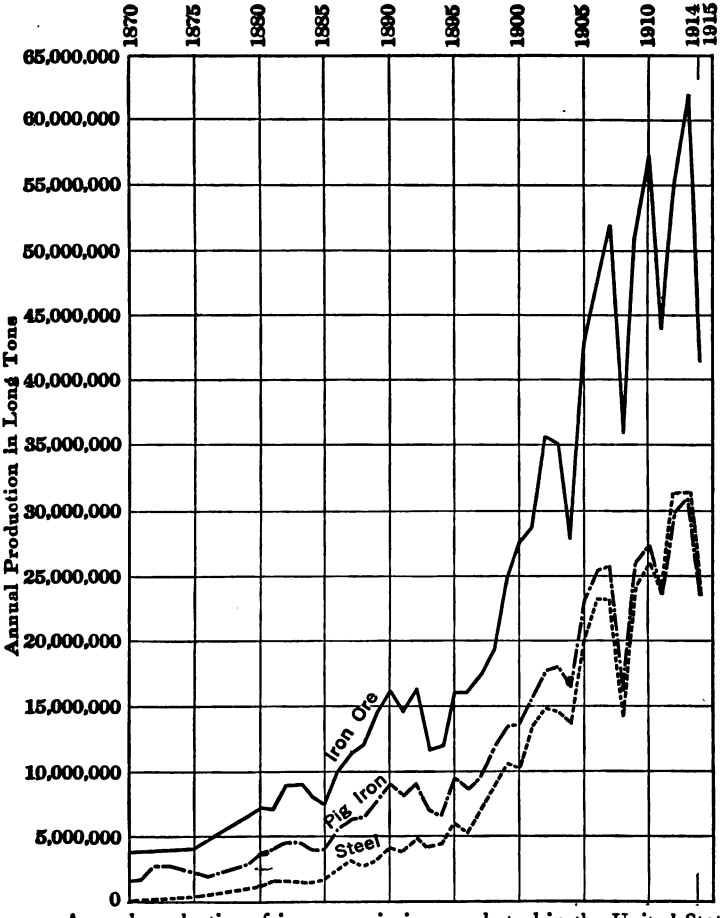

FIG. 3. Annual production of iron ore, pig iron, and steel in the United States, 1870–1914. (U. S. Geog. Survey.)

equal rates of growth, and our production in all lines increased largely. So far as the iron and steel industries are concerned, the growth during the period between the panic of 1873 and the World War is well brought out in figure 3.

But along with the growth of industrial output and of national wealth, which were of themselves very good things, there were some related or accessory matters which were not so pleasant to see. For during the three decades after the Civil War the United States fell to a low average level of political and business morality which had not been equaled before or since, and along with the rise of sudden and over-great fortunes we had also the rise, for the first time in America, of a conscious proletariat. The causes of the falling off from America's earlier moral and political standards was not far to seek. The men who had come back from four years of war, during which force was naturally looked to as a prompt solution of difficulties, were naturally not squeamish about the uses to which force might be put: and as for those who had stayed at home and sold supplies to the government, they were — just as our profiteers of to-day. In politics, then, we had a corruption which was shameless and unrebuked; and to realize the depths to which the nation had fallen we need only suggest the carpet-bag domination of the south, the Tweed ring in New York, the election of 1876, the Credit Mobilier. In business we did not rise far above the same moral level, and the era of railroad wrecking for profit was characteristic. Industrially, strange practices were allowed and even encouraged, in the name of competition; and the railroad rebate was the mildest weapon employed.

As the eighties passed away the standards raised again, and with the coming of Roosevelt the country came to accept, and to insist on, far higher levels of business and political morality. And in doing so it often forgot that the commercial practices of which it now complained had grown up naturally enough, under public knowledge and public approval. It was far easier to charge the blame to one man or to one group of men, rather than to admit that the whole public sentiment had been for many years at fault. It is worth while bearing these facts in mind when we

come to consider, and attempt to appraise, the great changes in the industrial structure which came about after the Spanish War.

For if the end of the nineteenth century saw the advance of the United States to world leadership in the great basal industries, it also saw the rapid massing together of former industrial competitors in great combinations or "trusts." The period from 1898 on to 1906 was the one in which this phenomenon was best displayed in America; it had taken place at a somewhat earlier date in England and in Germany. The forms which the new industrial organization tended to take, and the causes and effects of these re-groupings, will be discussed in a later chapter (Chapter XIX), and need not be further considered here, where we need only note that one of the first effects of the great consolidations was to aid markedly in creating an increased American export trade in manufactured commodities.

In colonial days the American colonies had been large exporters, for the times, but always of agricultural or practically raw products. This condition continued long after independence, and from 1790 to 1890 the agricultural products sent abroad steadily made up from 75 to 85 per cent. of the total value of our exports. In the last decade of the century this relation was to change very markedly, with a resultant increase in the importance of manufactured exports. The totals of our foreign trade had of course increased from year to year, and in 1892 our exports for the first time exceeded one thousand million dollars. Of this four-fifths was made up of agricultural products, mainly of course cotton, meats and wheat. Of the two hundred million dollars contributed by non-agricultural products, petroleum accounted for forty millions, and iron and steel manufactures for thirty, while wooden goods were valued at twenty-five millions, and leather manufactures at twelve. Perhaps the most direct summary of the situation, even at that late date, is simply to say that in the year of 1892 finished manufac-

tures, ready for consumption, amounted to only thirteen per cent. of our total export trade.

Two decades later the situation as regards exports had changed greatly. The total value of exports had about doubled, exceeding in 1912 two thousand million dollars. But this increase, though large in itself, was not so remarkable as the change in its components. Since 1892 there had been a steady falling off, not in the total of agricultural exports, but in their importance as compared with manufactures, and in 1912 for the first time in the history of the country agriculture contributed less than half of the total exports. The products which made up the other half were chiefly copper, petroleum and wooden products, each of which amounted to around one hundred million dollars in value. Agricultural implements, cars and steel manufactures were important, but less so than the three groups just named. Summarizing again, the finished manufactures amounted now to thirty per cent. of the total exports, as compared with thirteen per cent. twenty years before. The United States was fairly started as a competitor in world trade, and from now on would necessarily take a keener interest in world affairs — industrial, financial and political.

CHAPTER III

THE GROWTH OF GERMANY

In discussing industrial growth in Great Britain and in the United States, we have been dealing with a history spread out over one hundred and fifty years, and with a relatively even growth throughout that long period. But in taking up the question of industrial development in Germany we have to deal with a record whose real points of interest fall within a far shorter period, and which therefore gives an appearance of particularly rapid and intensive growth. It may be noted that, from the writer's standpoint, this rapidity of development was not an unnatural or isolated phenomenon, but that it is a consequence of the very radical differences which exist between natural physical evolution and social evolution. When we come to discuss Japan we will find a still more remarkable case of this sort, and we may reasonably expect that in future the world will come to realize that the *normal* development of a nation does not now necessarily mean its *slow* development.

But we may set aside these more general questions for later discussion, and for the present confine attention to the actual facts as regards the industrial growth of Germany. That is still a matter of the highest concern to the peoples of all the nations, not merely as a record of past achievements, but in its bearing on the future.

The period of slow development, prior to 1870. As we will see later, there are very good reasons, not only from the political but from the more important economic standpoint, for dividing the history of German industrial development into two parts, and for fixing 1870 as the date separating these two periods.

We can not undertake here to trace the gradual political evolution which built up a modern German Empire, as that existed in 1914, out of some of the states which had formed the Holy Roman Empire of earlier days. For our present purposes it will be necessary, however, to call attention to the fact that, prior to 1870, the word "Germany" was a very convenient but also very loosely defined geographic term, without any definite political significance. The vague and shifting significance of the word makes it very difficult to work out very precise comparisons of industrial conditions at different dates, for the older statistical data with regard to population, production and other factors of interest were naturally not grouped in accordance with our recent conceptions of the extent of Germany. An attempt has been made, in the discussion which follows, to make this grouping, and to consider the growth, as a unit, of the area which from 1870 to 1918 made up the modern German Empire.

As Europe emerged slowly from the Dark Ages, the areas which later formed the German Empire showed a relatively rapid growth in industry and commerce, so that for a time they were in these respects far in advance of most of the other countries of Europe. But all this gain, and more, was lost by the protracted struggles of the Thirty Years War, during which the territory of Germany was ravaged as widely and as thoroughly as had been that of France during the preceding English wars. Some estimates assume that at the end of this period of devastation the population of Germany was reduced to a third of its original numbers. We do not need to accept these estimates at their face value, but even a fraction of these losses would be sufficient to dampen down industrial activities, not for years, but for centuries. Fortunately the center of war activities shifted elsewhere for a time, and with the exception of destructive French activities in the Rhine areas, Germany was not again the main storm center until the time of Frederick the

Great. His wars, however, though temporarily exhausting, were carried on by the use of relatively small mercenary armies on both sides, and did not bring about the widespread destruction that had been characteristic of earlier, and would again appear in later, types of warfare. To get the destructive effects of war in their most complete form we must look to wars in which the whole populace takes an active part.

At the close of the Seven Years' War, peace again appeared in Germany for a time, and from 1763 onward there was in consequence a marked renewal of industrial activities. This date corresponds roughly, it will be recalled, with the commencement of the Industrial Revolution in England; and the progress made in Prussia and Saxony seems to imply that the new impetus to production was early felt there. The developments ran in the direction of textiles, as in England, and we have records of steam-run mills as early as 1788. But, after a short respite, Germany is again plunged into a long series of wars, at first unjustifiable attempts to crush liberty in France, but later entirely justifiable and popular struggles against Napoleonic absolutism, from the last of which she emerged only in 1815. Truly, if war is really ever "fresh and joyous," the German people by that time must have become the gayest in Europe.

From 1815 onward, a half century of peace gave at last free opportunity for industrial development in a normal way. After the first heavy rush of British imports in 1815-1816, and the world-wide commercial troubles which closely followed around 1819, this development took place in Germany as in the United States, showing its first real beginnings in the decade between 1820 and 1830. It will be of interest to make some comparisons between the two countries at those dates, in order to get some idea as to their relative position then, and their later rates of growth.

In 1830 the states which later made up the German Em-

pire had a total population of some 27 million, as compared with 13 million at the same date in the United States. Germany was then producing about 120,000 tons of pig-iron, as against perhaps 190,000 tons in the States; but on the other hand the German output of coal was then about five times as great as the American, being 1500 thousand tons against 300 thousand. We can assume, then, that though in iron production the United States was already well in the lead, the German states were probably much further ahead in general manufactures. Both countries, of course, were still unimportant by comparison with Great Britain, which at that date was producing some 700,000 tons of pig iron and probably well over twenty million tons of coal annually.

We might make a further observation on these German iron production figures, were we to study them more carefully, paying regard to the rate of annual growth during different decades. That would lead to the conclusion that, though the first great advance in rate occurred in the United States during the decade 1820-1830, the corresponding leap in production was not shown by the German iron industry until the period 1845-1855. Putting the matter into still more general form, we can fairly say that the commencement of intensely rapid industrial advance in Great Britain took place almost exactly forty years before it occurred in the United States, and sixty years before it started in Germany.

The facts just stated are of importance, as tending to counteract the idea that during certain given periods in world history development occurs about alike in all nations. This theory of progress is widely accepted, though it is rarely stated in such definite terms. It underlies the assumption, for example, that during the latter part of the eighteenth century there was a widespread Industrial Revolution, not only in England, but in all other countries. We will return to consideration of these comparative figures

in a later section, when the causes and average rate of industrial progress are under discussion. And at that time we will see also that another theory — that of "special national genius" for some particular line of development, is also confuted most clearly by facts.

Recurring to the progress of German industry, it can be said that the first sharp increase in rate of growth, so far as the coal and iron industries were concerned, took place after the revolutionary movement of 1848 in Europe had subsided. During those few troubled years there was little to incite industrial growth, and the final failure of revolutionary attempts led on the contrary to large German emigration to America. But soon after Europe came back to stable, even if autocratic government, internal improvements were commenced. Among these was the early Prussian system of State railways, and by 1860 there were close to seven thousand miles of railroad in Germany, as contrasted with 340 miles open in 1840. This growth directly and indirectly aided the iron and coal industries, and the output of iron showed its first great jump about 1853. The rise then begun lasted until interrupted by the world-wide crisis of 1857, but after a brief pause the development recommenced at a still more rapid rate.

To sum up, the German iron industry beginning after 1850 showed a very steady annual increase for a long period of years. In 1850 Germany was making about 400 thousand tons of pig iron; by 1870 this had more than tripled. The rate of growth was not as rapid as that of the American industry, but the fluctuations from year to year were less. There was promise of a sound and steady development in this as in other industries, in the German states as constituted and organized in 1869. But this status was not to endure, for in that year the German states were on the threshold of a decade of very remarkable military and political change — a period whose ideas, at first remarkably

favorable to intensive industrial growth, were later to have fatal developments.

Before taking up these changes and their effects, it will be well to get an idea of the growth which had been actually accomplished up to this time, in the states which were later to form the Empire. In 1870 Germany had a population of around 39 millions, an increase of some 45 per cent. over that of 1830. But her iron output was now 1400 thousand tons, an increase of over 1000 per cent. while her coal production had risen to 34 million tons, an increase of almost 2200 per cent. England was still far in the lead in both respects, but since 1830 both the United States and Germany had gained at a far more rapid rate, and were gradually closing up the gap. Turning to a closer competitor, Germany had during those four decades of peaceful growth passed France as a producer both of coal and of iron, though as regards iron the lead was very trifling. But as a matter of fact both Germany and France had reached close to the maximum of possible development with the ores and processes then available. The process that would make a cheap competitive steel possible was still in the future; the ores that could be utilized by such a process were still, so far as Germany was concerned, across a frontier. The next stage in advance is marked by the acquisition of the ores and the development of the process.

Robbery under arms, 1870-71. In dividing the history of German industrial expansion into two periods, 1870 has been taken as the dividing date. This is not because the rate of increase actually changed sharply at that date, but because the results of the Franco-Prussian war made very remarkable additions to the material bases upon which any future industrial development must rest, and also brought about changes in political conditions which would ultimately be of service in future industrial growth.

During the few years immediately preceding the struggle

with France, Prussia had come rapidly to the front as the leading German power, a condition which no statesmen foresaw ten years previous. In 1864, in friendly coöperation with Austria, she had attacked Denmark, while France and England watched the outrageous robbery with calm aloofness. Two years later, a quarrel over the division of the Danish spoils had resulted in the very speedy and complete elimination of Austria from German leadership; and had incidentally revealed, if any one had been interested to note the fact, that a great strategist was in control of a hard-fighting and very well-organized military machine.

Vague promises of territorial repayment elsewhere had kept Napoleon III neutral while Austria was being beaten, and now his own turn was at hand. It seems likely enough that the war between France and Prussia would have come anyway, at some later date, but unfortunately the exigencies of Imperial policy led Napoleon to accept a very poor opportunity indeed in 1870, and to place France in the position of apparently forcing a war with Prussia over a very unimportant question. The military and political credit of the Empire had been lowered by its abandonment of Maximilian in Mexico, and its moral credit had always been negligible. So the French emperor went hopefully to his last great adventure, and the French people were to pay bitterly for their twenty-year acceptance of imperial sham.

As for allies, there were none, much though this fact may surprise us to-day. England freed, by Bismarck's prompt assurance, from fear for Belgium, stood aside. Italy accepted the usual slight gratuity; Austria was unwilling to try again; Russia was positively friendly to Prussia for the time. So France, a little more unprepared than usual at the moment, went down alone to defeat. The struggle, as an organized war, was very short. The usual French gambit — an attack from the Lorraine salient — gave encouragement for only a day or two. After that it was a continuous story of French defeat and surrender. The staff

work was atrocious, and no amount of courage could make up for lack of both intelligence and supplies. The Empire fell, and after a brave but hopelessly disorganized attempt to repair the disaster, the new Republic was compelled to make peace.

Now, a word as to the extent and value of political prevision and planning, because this is perhaps the best available illustration of the limits of both. The results of this war had very great ultimate effects on Germany, on France, on England, and on the rest of the world. These effects were not only political and military, but industrial. They are recognized clearly to-day, and the general assumption is that the war of 1914 would never have happened if the war of 1870 had not been so completely won. All the excited, though pseudo-economic, war literature of all the countries, during the period 1914 to 1919, recognizes and proclaims these facts, with the result that we come to have a general idea that they must have been equally evident at the time, at least to trained observers.

But actually, when we go back to the books and papers of that period, in an attempt to discover just how the matter impressed the people of 1871, we find little trace of any recognition that anything serious had happened to the world. In France, 1870 was looked upon as a purely military and political humiliation, which the nation would hope to avenge some day by equally purely military means. In England, there was at first frank pleasure over the final elimination of Louis Napoleon, and perhaps a little quiet relief that the historic enemy across the Channel would be likely to give little occasion for alarm for some time, but after the fall of the Empire English liberals and others protested unofficially against the treatment which the new republic received; there was however not a trace, so far as can be found in the literature or speeches of the day, to suggest that anyone recognized the fact that a new and far more dangerous opponent had come to power. In Germany

itself the war seems to have been regarded, even by the statesman who conducted it, as a military and political success, which aided German unity, gave a good frontier,—and nothing more. Throughout the world there was not one trace of the idea, now generally accepted, that very obviously a new and dangerous military and industrial Power had appeared, with aims different fom those of other powers, and with different ideas as to the possible means for carrying those aims into effect. If indeed this was obvious to the men of 1871, it is remarkable that there was not a single politician, economist or soldier, in warring or neutral country, who expressed himself publicly to that effect. So much for political and industrial foresight.

And this last is very surprising, for in all truth the outstanding result of the Franco-Prussian war was industrial. It has been said, in a book written and published before the recent World War was in sight, that "the war of 1870 was in reality an exchange of blood for iron in a way that the world has not appreciated." To-day, with the rapid education that has come about since 1914, we can all appreciate the matter. Every journalist can now tell you that, at the close of the Franco-Prussian war, the boundary was drawn so as to give Germany half of the most valuable iron ore deposit in Europe, and one of the largest in the world. What he does not tell you, and probably does not yet know, is that though this statement is true enough, it was not understood at the time by anyone in either France or Germany. We have said something as to the limited foresight of the politician; let us see what trained scientific leadership accomplished.

The boundary line, as has been said, was drawn so as to include, as we now know, less than half of the Lorraine iron ore field. That it included so much seems to have been due to the direct efforts of German geologists; that it did not take in all of the field was due, partly to scientific stupidity and partly to an excusable lack of prevision.

From the memoirs and letters that have been published, we see that neither Bismarck nor the army leaders cared much about the matter, but did want an extension to cover Belfort. But France was obdurate about Belfort, and as a choice between two evils, preferred to give up more of Lorraine; while an eminent German geologist laid stress upon the importance of taking in the iron-ore territory. The idea was sound, but the execution was shockingly bad, owing to the prevalence of the scientific error that has been referred to above. As we now know, the Lorraine ores are of sedimentary origin, forming true flat-lying beds, and can be followed underground for great distances, like coal-seams. But in 1870 the weight of scientific authority held another idea — i.e., that they originated by replacement from the surface, and that therefore the ore would disappear a short distance below the outcrop. This, by the way, is one of the most persistent of scientific stupidities; it has been applied not only to Lorraine, but to the similar ores of Newfoundland and Alabama. In each case it has cost a good deal of money; and in the case of Lorraine it has cost a war.

So, under the influence of this idea, the boundary was finally drawn a relatively short distance back of the outcrop; and most of the known and visible ores passed into German control. Years later, the use of brains and drilling machinery demonstrated that the ores did persist in depth, and that the region that had been left in French hands was underlain by much more ore than had been turned over to Germany. This later work will be recurred to in discussing French development. At present, having mentioned the scientific error which had been introduced into the question, we may go on to the other important (and in 1870 equally unknown) factor which was to affect the value of these ores.

It must be realized that in 1870 the Lorraine iron region did not have the same relative importance, as compared to

other European areas, that it later assumed. This fact must be borne in mind in order to get a clear idea as to how the new boundary line was regarded by both German and French manufacturers. The difficulty then existing, and later overcome, was in relation to the composition of the Lorraine iron ores, a purely technical matter, but with very important industrial results. The Lorraine ores are typically high in phosphorus, and the pig-iron made from them is of course very high indeed in that element. That meant that in 1870 they were not ores that could be used in the steel industry, for the Bessemer process, as at first introduced, did not eliminate phosphorus at all. A pig-iron suitable for the original Bessemer process had to be practically free from phosphorus. This limitation left the Lorraine ores, as were our own Alabama ores at the same date, entirely worthless from the steelmaker's standpoint, but free for use where a very fluid cast iron was desired. They were strictly foundry irons, not steel-making irons. And the industrial world was then, under the stimulus of the large tonnages of cheap steel which the Bessemer process could yield, turning from the use of iron to the use of steel. Lorraine in 1870 seemed to have a good but very limited future.

But, fortunately for Germany as well as for the rest of the world, Lorraine was not the only region which had an over-supply of phosphoric iron ores. England was similarly placed with regard to her cheapest ores, Alabama was in the same straits, and the vast Newfoundland deposits later developed would show the same difficulty. So there was a direct incentive to the study of possible processes for making good and cheap steel from a high-phosphorus pig-iron. In 1870, however, there was no such process in actual use, or even well advanced experimentally.

The solution was to come from England, but not until 1879. In that year Thomas and Gilchrist, two remarkable cousins, gave to the industrial world a very convincing demonstration of a new steel-making process which they had

publicly described in the preceding year. This was the basic Bessemer or Thomas-Gilchrist process, whose essential feature was the use of a basic (line or magnesia), lining to the Bessemer converter, this lining making almost complete removal of any phosphorus contained in the pig-iron. Seemingly a very simple matter, the new process was in reality a very brilliant technical achievement, which resulted in wide-spread industrial changes. Primarily, it made it possible to utilize the cheaply operated Bessemer converter for making steel from a phosphoric pig-iron; but secondarily it put an actual premium on the use of such irons, for it was soon found that the phosphorus eliminated from the iron combined with the lime to form a phosphoric slag, valuable as a fertilizer. By crediting the sales value of this by-product against the cost of steel making, the new basic Bessemer process showed cheaper steel than did the old or acid Bessemer method. Iron ores high in phosphorus now had a new place in the industrial world, and the Lorraine iron region would come into its own.

The period of rapid growth, 1870-1910. In following out the later developments which gave the Lorraine ores their high recent value, we have over-run somewhat the story of industrial growth after the war.

Industrially considered, the actual spoils of the war were great enough even at their then value. The conquerors received the five milliards of gold, which incidentally was currently credited with being in large part the inciting cause of the great German industrial activity of the years which immediately followed, though this is a question. But in real assets they received an industrious population of one and a half millions, a large wheat area, a thriving cotton industry, and a well developed iron region. As regards this latter more particularly, we may say that it included not only the greater part of the outcrop of the Lorraine iron ore field, but a group of iron making plants. The eight or more plants which now found themselves on the German

side of the frontier had an output, just before the war, of some half million tons of pig-iron annually. Further, Germany also received that portion of the Sarre coal-field which had been left French in 1815 — a portion which represented perhaps a fourth of the entire field.

The direct and immediate gains through this affair were therefore considerable, and showed promptly in the swelling of the production returns of Germany with a corresponding falling off in French output, in the years following the war. The iron output in Germany proper, excluding Luxemburg, was for example in the year before the war 1290 thousand tons; in the year after the close of war, 1810 thousand tons; the gain represented almost exactly the product of the French furnaces acquired.

During the decade which succeeded the war, the Lorraine ores were still limited in use, owing to the conditions previously discussed, and the iron output of Germany rose only some fifty per cent. in the ten years. But with the invention of the basic Bessemer process in England, and its prompt adoption in Germany, the rate of growth quickens immediately. In the decade 1880-1890 the German pig-iron production increased almost one hundred per cent.; and in the two succeeding decades the same rate of progress was maintained. By 1910, therefore, Germany was producing close to fifteen million tons of pig-iron annually, as compared with the 1400 thousand tons of 1870 and the 120 thousand of 1830. Though the United States was still far in the lead as an iron producer, Great Britain had been passed by Germany around 1900, and industrial progress in other directions had been equally surprising.

CHAPTER IV

THE RETARDATION OF FRANCE

In the previous sections, when discussing the industrial development of Great Britain, Germany and the United States, we dealt with the effects of such growth in a group of singularly fortunate countries, where the progress once begun was allowed to continue peacefully until it had arrived at a high level. But in the case of France, now to be discussed, this was not the case. During the early period, when the British Empire and the United States were laying the foundations for modern industrialism, France was subjected for over two decades to an exhausting series of wars — wars which began purely defensively, upon her own soil, which ended, after brilliant intermediate successes, in final military defeat. Then, after a period during which industrialism had an opportunity to commence growth, there was again a defensive war on French soil, costly alike in men, territory and money. The development which had begun was for a time checked sharply, and finally thrown into new channels. It is only to-day that it is possible for French industry to recommence development along the lines that would have seemed normal in 1869.

Manufactures had begun early in France, as in mediæval Germany, but their growth had been checked by the same causes. For France the record before 1650 would include a century of English aggression, during which the greater part of France was laid waste by royal bandits; and then, after an interval of relative peace, another century of religious and other civil wars. From all this a strong power emerged, it is true, but in the face of constant exposure to external and internal attacks, the strength was gained only through the unhealthy development of overcentralized and autocratic government. In England, free

from serious fear of invasion or conquest, there had been a fairly steady growth of individual liberty and of popular control for many centuries. But in France, exposed on all frontiers, the early attempts at democratic institutions had left no successors and few traces. The manufacturing development which did take place under these conditions was necessarily to a large extent directly fostered and controlled by the state, sometimes aided by government bounties, more often hampered by government restrictions.

During the years of military glory which came to France between 1650 and 1750, the strain on the resources of the country was becoming heavier each year, and the population of all classes were suffering under the taxation necessary to support such glory. The Seven Years' War, more disastrous at sea than on land, resulted in the loss of the first French colonial empire, in the further contraction of French external commerce, and in a still heavier strain on the people. An autocratic government has only one real excuse for its existence — that it can more efficiently protect its people against external aggression than can a democracy. When it fails in even this, there is no longer any reason to tolerate it. With its unsuccessful foreign wars, and its crushing internal taxation and abuses, royal government in France was about to go the same road that, over a century later, would be followed by kaiser and czar.

Revolution and war, 1785-1815. For almost exactly three decades France was to struggle through internal reforms and revolutions, followed by external wars. But before we take up the industrial effects of these changes, it will be well to get some idea of the status of France, in this respect, just before the period of violent change had arrived. For this there are, fortunately, ample data; for the very centralization which hampered French development in some directions gives us better records than we have available for the early years in England and America.

In 1787, immediately before the Revolution, France was

mining a little over two hundred thousand tons of coal, and importing, chiefly from England, an almost exactly equal quantity. At that date, for comparison, the output of the United States was negligible, but England was producing perhaps six million tons a year. In the iron trade France ranked below England, the United States and the Baltic countries, but above her later competitor Germany. The domestic crude iron production may have been twenty thousand tons, but there were imports of almost as much, which went into further manufactures. Textiles, on the other hand, were in better relative shape, particularly the woolen and linen manufacture. An estimate of about this date places the value of French textile manufactures at 90 million dollars, of which the linen trade accounted for 25 millions.

The four years of political unrest which immediately followed were unfavorable to the growth of French industry, or even to maintenance of its 1788 status. There was a steadily increasing pressure of imports from England, due to the rapidly expanding British manufactures, and this at a time when the French market was being slowly but surely contracted, by the emigration of capital and persons from the kingdom. But this state of depression seems to have arrived at its climax before 1793, to be succeeded by the usual burst of feverish activity which always marks inflation of the currency. Left to itself this very inflation would have brought about a still more disastrous collapse of industry, but its effects in that direction were masked by the outbreak of war and the invasion of France. The other powers of Europe could no longer watch undisturbed the growth of liberty in France, and Prussia, Austria and England united to crush it. The issue joined then was not properly a question as between nation and nation; it was the issue between democracy and autocracy, for both sides realized that the two could not coexist on the European continent. It would be over a century before that issue was settled, again forced by an equally inexcusable invasion, again

to be justified by the same theory that an efficient autocracy must protect the world against an inefficient democracy.

During the two decades of constant war which followed the Revolution, France was to learn that a strict enemy blockade is in reality a far more efficient stimulus to both invention and manufacture than is a protective tariff. The United States had an almost contemporaneous experience, of much the same type, pointing in the same direction, and the Confederate States of America were, at a much later period, to show the same effects.

The French coal output, for example, almost quadrupled in a decade, for in 1802 the domestic production had risen to over 800 thousand tons. This was a rate of growth rarely shown in any country at any time. Imports of British coal had ceased, it is true, so that the increase in domestic mining did not attain a corresponding increase in consumption. But there was still a hundred thousand tons of coal annually coming in from Belgium, Westphalia and the Rhine Provinces, and when this is allowed for we find that actual consumption in France had more than doubled in a decade. The increase was not kept up for many years, however, for in the long run the steady drainage of men would necessarily tell on industry. With the beginning of final failure, in the Spanish and Russian adventures, coal output falls off slowly, reaching less than 700 thousand tons in the critical year 1814.

During this same two decades of enforced protection, other industries had shown equal or even greater development. The domestic iron trade, for example, had more than quadrupled, probably reaching close to 100,000 tons annually during the more prosperous years of the empire. It, too, fell off toward the close of the period. Meanwhile the textile industries had grown largely. Chaptal's estimate of 1812 places their annual value at some 160 million dollars, a growth of over 75 per cent. since 1788. Of this total, wool and linen accounted for almost a third each,

while silks and cottons made up the remainder. There had been French invention at work, as well as adoption of English machinery, during the intervening period, for Jacquard had invented his loom in 1804. For comparison, the value of French textile industries about 1810 may have been two thirds that of Great Britain; the total value of all manufactures perhaps half that of her rival.

The first developments, 1815-1870. During the period between Waterloo and Sedan, French industry pursued its growth unchecked by external aggression, limited only by its natural resources and by the vagaries of internal politics. With regard to the latter point, France was not alone in her misery, for Great Britain and the United States have passed through much the same experiences during their industrial growth. But so far as the question of natural resources is concerned, the cases are not similar in the slightest degree, and this fact must be borne in mind when we compare industrial development as between the nations. Hitherto, in outlining the history of such development in Great Britain, in the United States and in Germany, we have been dealing with three countries exceptionally favored by nature in two very important respects — the presence within their boundaries of large and cheaply mined deposits of coal and of iron ore. Now, when we come to deal with France, we have in hand an example of entirely different type — of a country deficient in the most important of these raw materials, and whose development has consequently followed different lines.

At the close of the Napoleonic Wars, however, this point was not so evident, for except in Great Britain coal developments were relatively slight all over the world, and their ultimate importance was not anticipated. Furthermore, though the Allies had turned over to Prussia the bulk of the Sarre coalfield in 1815, they had permitted France to retain the smaller portion of that basin which was in Lorraine, with several producing coal mines.

France passed, like all the world, through a long period of depression after the great wars, and in 1836 was making but little more iron than in 1815. The first real growth, as in Germany, took place around 1850, and was apparently due to the same local inciting cause — the development of railways. At any rate an iron output of perhaps 100,000 tons a year in 1830 had become 800 thousand tons by 1860, and reached one million tons in 1864. But at this point increased output stopped for a time, and it was not until 1869 that the million ton mark was again reached, only to be followed by the disaster of 1870. The effect of the Franco-Prussian War, and of the peace which followed it, have been discussed in the previous chapter, and the matters involved need not be brought up again here. It is sufficient to say that France lost the remnant of the Sarre coal field, the bulk of the known Lorraine iron ores, several groups of furnaces, and a large fraction of her cotton industry.

Renewed development, 1871-1910. After the losses of the war and of the peace, there was a year of uncertainty, industrial as well as political, and then France commenced to rebuild her wrecked industries. The free-trade treaty with England, which had depressed French iron manufactures in the decade after 1860, was not renewed, and from that time on France became even more strictly a protectionist country. The iron industry, however, was still hampered by purely natural restrictions as to coal and ore supply, and its slow growth even under protection throws light on the inadequacy of the latter, alone, to force output. The iron output, which as has been noted had reached one million tons by 1864, did not pass the two million ton mark until after 1880; and then, for over a decade, showed no advance whatever. From 1898 on there was another period of growth, so that the iron output reached four million tons by 1910, and over five million tons in 1913. These rates of growth, it will be seen, were very slow by comparison with these shown in the United States and Germany

during the same periods, so that France was losing ground in this one industry, relative to the two leaders, but not compared to the rest of the world. Just before the World War the French iron output amounted to about six per cent. of the world's total. There had been indeed little change in her rank or percentage since 1850, for though America and Germany had grown faster, England had fallen off in rate of growth, and none of the newer competitors could as yet aspire to France's position.

The difficulty which France had experienced in the development of the iron industry was of entirely natural origin, and could not be overcome even by high protection. Her coal supplies were small, relative to those of other great industrial nations, and even this supply was, with the exception of one large field along the Belgian frontier, widely scattered in a large number of small deposits all over the country. No closely grouped large industry depending on heavy use of coal could grow up under such conditions. On the other hand, these very conditions were an inducement to a system of scattered local manufactures which might nevertheless yield a large total output, particularly in such industries as used only small amounts of fuel; and that is what really occurred. France became perhaps the best modern example of widely scattered industry, as compared with the highly concentrated industry grouped around great coalfields, which arose in England, Germany and America.

The final result of the natural factors involved has been the creation, in France, of a number of small manufacturing centers, and the development along lines in which fuel is not a principal component of cost. France has therefore produced the textiles, particularly silks, cottons and woolens; high-grade clay products, such as porcelains; and other products of similar highly finished type. For special reasons, the occurrence of bauxite in southern France and the electric power available along the upper Rhine, the aluminum manufacture has been greatly expanded.

CHAPTER V

THE STIRRING IN THE EAST

Meanwhile, during the later years of the development whose history in western Europe and North America has been sketched, a change of great future importance was taking place elsewhere. Asia was beginning an industrial career along modern lines, with all that this implied.

For many centuries European trade with the East had been carried out, and at times on a very large scale. But this trade had always, from the European and later from the American standpoint, been a question of finding a good market for finished products, and of securing local raw products in exchange. Silks and porcelains had been about the only manufactured goods brought from China and Japan to western markets. The bulk of the eastern shipments had been along other and strictly non-competitive lines — teas, camphor, spices.

The eastern trade had progressed, but not in an entirely smooth and uninterrupted way, for the two great Eastern Nations had not been able to appreciate immediately the benefits of European intercourse and civilization. In the middle of the nineteenth century Great Britain had even been forced to war on China, in order to compel that unwilling and backward empire to accept opium. But these eastern markets had been too good to lose, so Europe and America had put up with many discouragements and difficulties in order to secure a dumping ground for manufactured goods at high prices. Now, toward the close of the century, a change came in the affairs of the East, and a new specter arose to trouble the dreams of diplomats. We had just become accustomed to thinking of "lower races" in terms of the comforting theory of the White Man's Bur-

den, when we were startled to find that part of the burden had ideas of its own on the subject, and curiously independent ideas at that. The weight of the burden was lightened, but to compensate for that relief the shadow of the Yellow Peril fell over the western world. And that has never lifted.

Prior to the political and industrial awakening in the East, western ideas as to the two great Asiatic powers had been very indefinite, and not particularly farsighted. We knew that China contained a vast population, who wore pigtails, made dinner plates, and fought with firecrackers. The Japanese were small people who spent their time drinking tea under the cherry-blossoms. We knew also that the two countries furnished a very good market for cotton goods, and that therefore any foolish Asiatic ideas as to non-intercourse must be sternly suppressed. Finally, constant demands for money reminded us that at a very large expenditure per head a very small percentage of these heathen could be reclaimed, and made into real Christians, though even those converts showed a strange reluctance to adopt European habits and vices. There is very little exaggeration in the preceding summary — it probably represents fairly the knowledge of China and Japan possessed in 1870 or even 1890 by the average European or American statesman.

But even more embarrassing than general lack of knowledge as to Asiatic possibilities was the fact that, of the two possible contestants, Europe in general backed the wrong horse. The truth was that most of our Asiatic misinformation was derived, directly or indirectly, from diplomats and missionaries. Now these two classes made a very natural error. They were greatly impressed by the vast extent and mere bulk of Chinese territory and population; they could not realize that quick intelligence and activity might for a time at least, make up for this mass. It was the Russian myth over again; for it was exactly the same as

if an Eskimo or Argentino had been brought from his plains to Europe, to be greatly impressed by the vast expanses of Russia, and to think little of the workshop island off the European coast.

War, immigration or competition. As to the exact form which this Yellow Peril will take, that is a matter for wide differences of opinion and prophecy, depending perhaps in large part on the personal ideas and tastes of the prophet. A distinguished personage, now temporarily residing in Holland, has been the leading exponent of one school of thought. He saw the future conflict as the incursion of vast hordes of barbarians, sweeping over Europe from the Urals to the Channel, submerging beneath them all traces of civilization, destroying mines and mills, cities and cathedrals, killing women and children. His ideas may be correct; they certainly are natural enough, and they are shared by some military authorities and many civilians. To their holders the only possible defenses against the Asiatic advance are military preparations — and the partition of China among civilized powers. The school agrees on this general program, though there are some minor differences, notably as to which Chinese provinces would furnish the surest guarantees against the Yellow Peril, and as to which powers should undertake the greater share of the White Man's Burden.

To another group, the serious feature of the situation is the assumed over-population of the Far East, and the danger that less crowded countries will be crushed down by the weight of undesirable immigration, with consequent lowering in both wages and in living standards. These views have a more solid basis in fact than those just mentioned, and are accepted pretty generally in Australia, New Zealand, British Columbia and the western United States. The remedy suggested is, inevitably enough, more or less complete racial exclusion.

A third school of thought, however, tends toward the

belief that the development of the Far East will express itself, at least for a long time to come primarily in the form of increasingly severe industrial competition from a base on its own soil. I believe that this is the correct viewpoint, and I believe further that the possible rapidity and extent of that competition are generally very much underrated.

For it is to be noted that all three schools agree on certain basal facts, and disagree merely in the possible consequences. The point of agreement is as to the existence of a tremendous mass of man-power in the Far East — of a huge population with hard-living industrious habits, of a low standard of living, and of but slightly developed industrial openings. Considered without reference to natural conditions as to raw material supplies, there is little reason to choose between the three schools of thought, but when we come to examine this question later it will be seen that in China we are dealing with one of the great coal reserves of the world. Under these conditions the form which development of the yellow races is likely to take seems less uncertain.

So in real life the danger of Asiatic development is likely to express itself not in the form of a Japanese guard in your city hall, or of Asiatic laborers in your factories, but in the form of Chinese rails and woolen goods underselling your products, at first in neutral markets, later perhaps in your own. The fact that this competition will not take place in this year or this decade, the further fact that, for reasons later stated, it will not last forever, does not in any way lessen the seriousness of its probable effects during the period that it will be in force.

The development of Japan. The first real sign from the East, despite earlier ideas as to the two nations, came not from China but from Japan. Here, within the two decades 1871-1891, a feudal nation was entirely recon-

structed along modern industrial lines. The rapidity of the transformation lends point to what was said previously in connection with German development — that in future we may fairly expect to see a very great speeding-up in such processes. It is no longer necessary for a nation to pass through a century of preparation, as did England and the United States; technical training and massed capital are now available in such quantities as to bring about great changes in a few years. Given an urgent necessity, for example, it is likely that China could be made into the third or fourth largest iron producer of the world within twenty years.

From the earliest days Japan's relations with Europeans had been difficult. A marked missionary effort by the Jesuits in the sixteenth century ended in attempts at political interference, and the final expulsion of the missionaries and the stamping out of native Christianity. Shortly after that the Dutch traders reached the islands, and as a Japanese document naïvely says, "sent a memorial to the Shogun intimating that those who profess Christianity have treacherous motives." The distinction between Christians and Dutchmen being made plain, the latter and the Chinese were permitted to send occasional ships to Japan, but all other nations were barred.

Beginning about 1800 European attempts to open commercial relations occurred at intervals. Refusal to treat with Russia was followed by a sudden attack by Russian vessels, the devastation of one of the islands, but the final defeat of the invaders. Around the middle of the century came our own efforts, carried out in more decent fashion, and finally successful. Beginning with 1856, various treaty ports were opened to foreigners, and the decade which followed saw the negotiation of commercial treaties with all the leading nations of America and Europe.

Once begun, the modernization of Japan spread fast.

The adoption of various factors in modern communication and finance is shown as follows:

First telegraph line in Japan	1869
First railroad in Japan	1870
Modern post office system adopted	1871
Coinage system remodelled	1871
Japanese ocean steamers operated	1875
Yokohama Specie Bank founded	1880

Along with this there had been great changes in Japanese industry. The older types of manufactures persisted, as indeed they do to this day, but a large development also took place along other lines. This was speedily notable in the decade 1885-1895, when modern plants were established to manufacture cotton goods, cement, matches, heavy chemicals, paper, soap and glassware. Shipbuilding also commenced along modern lines at this time. Some idea of the external effect of these changes in commerce and industry is afforded by the fact that the Japanese exports rose from less than thirty million dollars in 1885 to over eighty millions in 1890.

The proofs that Japan had rapidly become a great civilized power were not, however, afforded so strikingly by her commercial development as by her successes in war and diplomacy. Europe had hardly time to recover from astonishment at seeing the war with China finished very decisively in favor of Japan (1896), when the naval alliance with Great Britain renewed uneasiness. Finally, the very unexpected and complete victory over Russia made it evident that Japan must necessarily be treated in future as one of the great powers.

CHAPTER VI

THE STRUGGLE OF THE NATIONS

It is now a commonplace that the Victorian Age was a period marked, in all its phases and activities, by utilitarianism and stodginess, by convention and stupidity. This very fact should rouse us to doubt, for whenever an idea becomes generally accepted it is almost always untrue. And the present case does not offer one of the rare exceptions, for in all truth the latter half of the nineteenth century had in reality many claims to our respect as well as gratitude. There had been great industrial development, and it is true that much of this had ugly enough immediate results. But with all this there was a quick sympathy with the oppressed, within the nation and without, and efforts to ameliorate or remove the evils that were found to exist. Perhaps the remedies suggested and applied were not sufficiently radical, but they were offered in all sincerity, and applied with a generosity, as between class and class, or nation and nation, such as had never been seen before. The world seemed to be working slowly but steadily toward a condition of things which was to be marked by the further development of individual liberty and national wealth; and this was to be accomplished by the stimulation of individual enterprise, and by free competition, but not by armed conflict in the nation or without.

But with the passing of the Great Queen a new and harder note was heard. The old creeds and the old loyalties had long been undermined, and now the masses were ready for new revelations. Under the able guidance of politicians and journalists and labor leaders they had not far to seek.

The scientific advances of the past half century had all tended to lay stress upon the universal applicability of evolutionary theories, and when these were applied to social problems, and pushed to their limit, in a purely materialistic way, there were opportunities offered for trouble. If there were no gods, why dream of generosity or self-sacrifice? If this world be all, why not possess it now? If natural evolution govern all progress, why not allow survival of the fittest to operate logically, and put an end to weak states or to weak classes within the state?

If we accept the premises, the conclusions reached are certainly logical enough. It can be seen that they operate in two directions, affecting two quite different groups, both powerful in modern states. And in consequence we had, all over the civilized world, two very different doctrines preached, though both had originated from the same general line of reasoning, applied however to different basal facts and conditions. The doctrines which became popular everywhere, one with politicians and the other with laborers, were Imperialism and Syndicalism. One held that a strong and well organized state is free from moral obligation in its dealings with weaker or more primitive nations. The other held that a strong and well organized class is free from moral obligation in its dealings with a numerically weaker class in the same nation.

Most of us are guilty of having accepted, or at least tolerated, the Imperialist doctrine; and for that we have paid bitterly enough in the four years of war that has ravaged the world. The other doctrine most of us have not accepted, and that struggle is still before us. Militarism and Syndicalism, though perhaps equal curses to civilization, can not co-exist; because one appeals to nationalistic ideas and the other to internationalism. The immediate effect of the World War, therefore, was to postpone until its close the class-struggle preached by the syndicalists.

When the long-expected war finally came, its immediate

cause was neither modern, nor industrial, but purely dynastic and political. An assassination, used as a pretext to extend Austrian overlordship in the Balkans, a countermove by Russia — and a very inflammable world took fire. Nation after nation was drawn in, some by existing treaties, some by violations of treaties. But in none of this was there any trace of industrial influence for war. Its effects appeared at a later period, in broadening the scope of the war, in changing its methods, and in fixing its final results.

We are not concerned with the history of this war, so far as the record of purely military events is involved. But at various times, from the first days of the war to its conclusion, there were matters which must be noted, as bearing either upon the industrial conditions of the war itself, or as throwing light upon its possible consequences, industrial and social. Three among these points of interest appeared within the first month of the war, and will be discussed first. One of them was a purely psychological phenomenon, which has been witnessed before, and will often be seen again; it was the immediate change in the attitude of such bodies as the Socialist and Clerical parties as soon as war was declared. The second was the almost immediate loss by the Allies of an initial industrial preponderance, a loss which prolonged the war and changed its character. The third was the failure of prevision regarding the probable course and duration of modern war.

The failure of internationalism. At the outbreak of war, many things happened as had been expected, though perhaps more rapidly than one would have thought possible. But, on the other hand, some things happened which could not reasonably have been foreseen, and the most important of these was the immediate and complete breakdown of internationalism in the socialist parties of all the warring countries. That belief in the international unity of the laboring classes of all countries, as against national or patriotic claims, was swept away over night, as if by magic,

and the day of mobilization saw the passing of L'Internationale and the coming of the Marseillaise. There was no question of calm judgment, on either side of the matter, and the temporary victory of the national over the labor creed was merely that of a strong primitive emotion over a new and less fixed belief. But the change was so striking, not only in France but in Belgium and Germany, that it afforded one of the chief points of interest to the earliest days of the war. It was so sudden and so complete that it raises the question whether the chief blot on the record — the murder of Jaurés — was not a blunder, as well as a crime. At the moment it may have seemed necessary for the safety of France, but in all probability the Socialist leader would have been swept away with the others in the reaction from internationalism to patriotism.

From the moment when, in all the countries, Socialist leaders voted for the war credits, the emotional or religious value of that creed was ended, and for the remainder of the war there was no need to consider it further. After the war was ended, the question would rise again to vex the nations.

The churches, too, were affected by the prevailing emotion, and in all the warring countries Christianity, like Socialism, lost all of its international tendencies and became purely nationalistic. This was the case even in France, where the Church had been for decades suffering under the abuse and spoliation of socialist administrations. But when France was once more in danger, all this was forgotten, and the Church set aside its just grievances in order to aid the State.

The loss of industrial preponderance. The war opened, on the western front, with two military moves which immediately introduced industrial factors of the greatest possible importance, affecting the fortunes of the struggle throughout, and indeed threatening to bring it to a decisive and early close in favor of the Central Powers. One of

these moves, the German invasion through Belgium, has been discussed in print to the point of weariness, but the discussion has been almost always confined to its ethical bearings, and has laid little or no stress on the point in which it now interests us — the industrial danger into which it brought the Allied cause. The other move, preceding the Belgian invasion in point of time, was the withdrawal of the French troops behind the frontier — and this is rarely mentioned at all, though in point of fact it was almost equally disastrous. The two points may be briefly discussed in regard to their industrial effects.

On July 30th the French Ministry of War telegraphed instructions for the putting in position of the covering troops, the units which were designed to conceal the actual mobilization of the armies. But in place of these covering units forming a screen close to the frontier, as had been contemplated in the general mobilization plans, it was specified that they were to be withdrawn to a distance of ten kilometres (say six miles) behind the frontier. This restriction had no military reason, but was political in its origin. It was still uncertain as to what attitude England and Italy would take, and it was thought best to avoid any chance of a frontier clash which could be used by the Germans as a plea that France was the invader and aggressor. As a political move it was successful and so perhaps justified, but it threw practically all the ore mines, blast furnaces and steel works of Lorraine into German hands before war had really begun. Almost half of the French iron and steel producing capacity was lost before the struggle had fairly commenced. Industrial Lorraine would remain German until American troops re-occupied it in 1918, and for four years French-built mills would supply munitions to the invaders. Such were the consequences of political intervention in a military and industrial problem.

Turning to the Belgian question, we need only summarize the story of another industrial disaster. The opening

move through Belgium had been discussed in military literature for many years, and its possibility had been universally recognized. The original French concentration had, however, been faulty; and Belgian delays in asking assistance had complicated the matter still further. It was not until August 4th that Belgium appealed to France and England. French troops were shifted westward, English troops were sent over to join them; but the combined forces available on that portion of the front could not withstand the weight

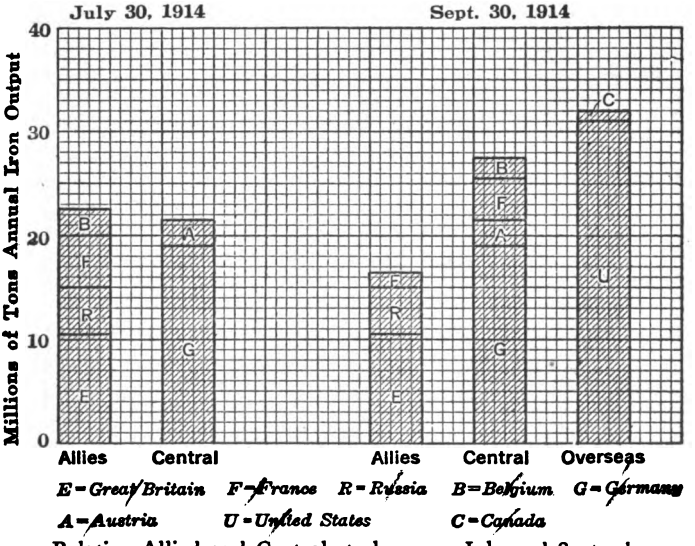

FIG. 4. Relative Allied and Central steel power, July and September, 1914

that was massed against them. A month of rearguard actions, between Charleroi and the Marne, and then in September came victory and the resulting German retreat to the line of the Aisne. From a purely military standpoint all seemed hopeful; but when the Germans dug in along the Aisne all of the Belgian and northern French coal fields were north of their lines, and so were all of the Belgian and most of the remaining French steel plants.

The diagram presented herewith (Fig. 4) shows in very striking form just what had happened, so far as iron and

steel producing capacity was concerned, during the very earliest weeks of the war. At the outbreak of war the Allies had an annual capacity of some 22½ million tons of iron, as compared with the slightly lower capacity (21½ million tons) of the Central Powers. But the occupation of Belgium and of northern France had changed these relations most unfavorably for the Allies, for at the close of that

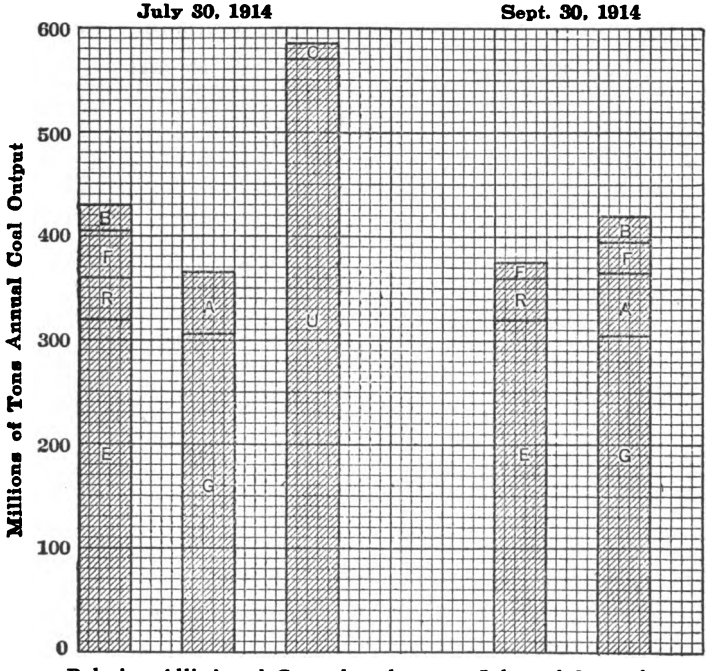

FIG. 5. Relative Allied and Central coal-power, July and September, 1914

first war stage the Allied iron capacity was only about 16 million tons, as compared with the Central Powers' 27½ millions.

With regard to coal producing capacity, the results were hardly less ominous, as shown in Fig. 5. Here we see that, as in iron and steel, the Allies had lost their original preponderance in the first days of the war. In July the Allies

had a coal producing capacity of some 425 million tons, as against the 365 million tons of the Central Powers. But the loss of the great Pas de Calais-Nord coal basin had thrown the balance the other way, so that in September the Allied capacity was only 370 million tons as compared with 420 million tons in the hands of the Central Powers.

The ultimate results of these conditions as to coal-producing and steel-making capacity now are obvious enough to all of us, but at the time they were not so evident, and it was months before the first possible implications seem to have permeated the political and military intelligence on either side.

For the Central Powers, the war had now been reduced to very simple elements, once the balance of industrial power had shifted as above described. So far as the western front was concerned, the war was definitely won, provided that the lines of September 1914 could be held, and provided that no new industrial factor intervened. There was no need to waste a single man in any fruitless attempt to advance beyond these lines at any point; but it was absolutely necessary to hold the lines firm; and it was of still more importance that the advantage so gained should not be overthrown by the introduction into the problem of the overwhelming tonnage from overseas. For, if we refer to the two diagrams above, we will see that neither of the great European groups had either coal or iron capacity large enough to count seriously against what could be contributed from North America. In the third column of each diagram the United States tonnage has been plotted; and to this is added in each case the Canadian output, because it was subject to the same limitations of supply across the Atlantic. As a counterbalance against not crediting Canada to the Allied column, the Swedish steel output has been omitted from the Central Powers supply, where it could

reasonably have been placed since throughout the war Sweden was rather more benevolent (to Germany) than neutral. .

For the Allies, the situation was equally clear, but less easily met. It implied that the war was lost unless the German seizures of the first few weeks could be regained, and this involved active attack rather than the passive resistance which was open to the Central Powers. Further, it would be necessary in case the industrial balance could not be quickly re-adjusted in Europe, to bring into the scale the vast North American tonnage, or at least such portion of it as could be bought and safely transported. This latter phase of the matter led naturally to more and more attention being paid to the questions of finance and shipping, and in the end it had a decisive and unexpected result.

As for immediate effects on military operations, we may therefore say that after Belgium and northern France were once occupied, the Central Powers were not compelled to do more than hold them, and were to some extent left free to undertake similar operations on the Russian front, which also had its industrial centers near the boundary. But the Allies were forced to attack on the western front, and by preference to attack at some point where victory would mean immediate return of some of the industrial spoil. Left as a purely French military and industrial problem, this would probably have implied attack on the right, so as to regain the Briey-Longwy region. But as an English-French question it was more complicated, and until late in 1918 it was always interpreted as implying the necessity of striking on the left, through western Belgium.

We must not, of course, accept the statements which have so far been made, as to the importance of iron and coal preponderance, in too strictly materialistic or fatalistic fashion. Under ordinary conditions they would have had far less effect upon the course and results of a war, but carried out as this war was, the question of munitions supply

became all important, and here coal and iron resources reached their maximum of military and political effect. It is very unlikely that in any future struggle they will again exert so much influence.

The failure of military and financial prevision. At the moment that the Germans definitely accepted the Aisne line, the war just as definitely changed its character and scope, though no one could have said so at the time. For during its first month the war of 1914, as it was then fondly called, had followed much the course of all textbook conceptions of what a modern war would be like. There had been nothing strikingly new about its methods or results in Belgium, during the retreat, or at the Marne; and indeed the only great technical change from 1870 had lain in the free employment by the Germans of very heavy guns and mortars, which had been brought up and moved with far greater freedom than had been thought possible. Granted the free use of large-calibre mortars, such incidents as Liège and Maubeuge followed as a matter of course.

But from the latter part of September, 1914, onward, some new features of more than military interest were gradually to become obvious. Industrialism was to take a hand, and show just how thoroughly destructive modern warfare can be made, when it is carried to its logical conclusion. War was to be no longer a purely military struggle, between two armies, but a far more bitter struggle between the peoples themselves, and all the resources of the new industrialism were to be massed for that struggle.

Financial prevision had failed us, no less than had military. For many years it had been preached that great wars were impossible, because of the close financial relations between the international banking groups. This hope had collapsed completely at the outset of the struggle, when it was seen that no nation hesitates to enter a war because of financial conditions. It was later to be learned — a lesson that indeed might have been learned earlier from the five-

year defense of the Confederate States — that no nation ever loses a war because of financial troubles alone. The feeling that the World War would end because of money difficulties proved illusive.

The industrial preponderance regained. The United States finally entered the war — just in time, as we know now, to save Europe from German domination, but three years too late to save civilization from terrible losses and future danger. In these three years we had ample time to find the profits that accrue to benevolent neutrality, and those we seized greedily. But we had also opportunities to make reasonable preparation for a war, and this we did not do. The result was that the final sudden demand for supplies threw unnecessary strain on the industrial structure, and increased the difficulties which always accompany war conditions. During this period of frenzied production world credit finally broke loose from any connection with a gold basis, and prices took an upward course which has had evil effects, to which we will have to recur later in this study.

Judged externally, the Allied fortunes reached their lowest point after the United States had entered the war, rather than before it, for the complete collapse of Russian morale and the Italian military disaster had marked the spring and fall of 1917, while as yet there was no very evident aid afforded by America. But in reality the balance had now gone so heavily against the Central Powers that their fall was merely a question of time. No possible military success, even the capture of Paris, could alter the fact that in the long run they would be crushed under the weight of superior coal and iron resources and man-power.

There was, furthermore, a nearer and more immediate blow to German hopes. The Russian Syndicalist movement, encouraged by Germany at first as a means of weakening Russian patriotism and breaking Russian resistance, had gotten beyond control. It had run the natural course

of all collectivist movements, though more rapidly than might have been expected, and the universal breakdown of industry killed all hope of getting food or other supplies from Russia. The danger now was that this movement might spread to Germany itself, and the only hope of victory and safety lay in a very quick and complete success.

The attempt at a military success in the west was accordingly made in the early spring of 1918. Its initial gains forced America to send men over in numbers, and so merely hastened the end. A final German effort in July failed to gain ground, and from then on the record was merely one of continuous and increasing gains by the Allies, until the German lines rested close to their own frontier. Hastened apparently by the fear that the German territory would be subjected to the ravages of war, as had been that of Belgium and northern France, an armistice was asked — and granted by a world too weary of war to be desirous of continuing even a just war one day longer than was necessary.

Industrial and political consequences. So far as the future of industrialism and of world competition are concerned, the war just finished has had very important consequences. Some of these seem to be commonly overlooked, as when we talk about the reëstablishment of Germany and Russia in terms which might perhaps have been justified in 1916, but which are no longer based on actual conditions.

So far as Germany is concerned, for example, we must bear in mind that she has lost practically all of her cheap sources of iron ore, and a very respectable fraction of her coal reserves, while another large coal field is at least temporarily alienated. France, on the other hand, has now certain possibilities, given even fairly sane government action, in the line of becoming one of the great world competitors in heavy products.

Meantime Japan has somewhat strengthened her position as regards coal reserves, while another of the Allies has quietly absorbed one of the great petroleum supplies of the world. Russia, on the other hand has lost ground, both through internal and external troubles, and seems even less likely than before the World War to become one of the great manufacturing countries of the future.

In the light of these facts we must to some extent revise our previous ideas as to the relative present and future importance, both industrially and politically, of many countries. These matters will be discussed in more detail at a later stage of this study, when we come to the question of the probable future of industrialism and of world competition.

CHAPTER VII

THE CAUSES AND EFFECTS OF INDUSTRIALISM

In the preceding chapters the history of modern industrial growth has been followed in each of the leading industrial countries from its beginnings to the present day. But if this historical sketch is to be more than a mere record of accomplished fact, it must have yielded suggestions, at least, as to some of the more general features connected with this industrial growth. The only value of historical study in any line, whether political or industrial, is as it throws light on the conditions of the present, or offers aid in meeting the problems of the future. With this in mind, it will be well to go over the story of the great development, as it took shape in different countries, and to group and summarize the more general features that seem to have been brought out in the course of the study.

When this is done, starting without any preconceived ideas as to the causes, the trend and the effects of the new industrialism, the following facts seem to have been of such general importance as to justify further consideration:

1. The change from old to modern forms of industrialism was in large part a natural evolution, and relatively slow. But at certain periods the rate of change became so rapid that the term Industrial Revolution seems justified.

2. The Industrial Revolution did not take place at the same time in all countries, and has not taken place yet in some countries. In Great Britain it arrived some forty years before reaching the United States, and sixty years before it affected Germany.

3. The rate of growth has not been uniform throughout the world, but is affected in large part by purely local conditions as to population, supplies, and markets.

4. The growth is not steady and continuous, but very irregular. It progresses by periods of world-wide industrial activity, followed by periods of depression. Among the broader causes which seem to have incited or aided the periods of general activity have been mentioned, at various points, such matters as extension of markets through new developments, improvement of transport, and increase of gold supply.

5. World-wide activity or depression are accentuated or produced by local conditions, and often by legislative or political factors such as differing attitudes toward tariffs, currency, and restraint of trade. The human factor therefore enters into the question, but it is generally subordinate in its effects to the more continuously operative natural influences.

6. During the growth of industrialism there are certain general tendencies manifested in all countries with regard to the form and structure of the industrial organism — its increase in size of unit, geographic expansion, integration of the industry, etc. Such tendencies, however, are greatly influenced by purely legislative and political factors.

7. Technical progress, like progress in output, seems to be rhythmic, showing periods of large advance followed by periods of little progress. To some extent it may be encouraged or discouraged by intentional human effort.

8. Industrial growth has had, as incidental effects, increase of population, formation of great working centers, wide fluctuation in prices, and great changes in labor conditions.

9. Internationally considered, the modern type of industrialism offers increasing opportunities for friction, with regard to such matters as tariffs, raw material supplies, colonial expansion, and immigration.

10. Industrialism has not, however, increased the frequency of war, and it has not directly caused any modern war. But it has operated to broaden the field of strife,

once a war is commenced, to profoundly alter the methods and practice of war, and to increase the material and other damage caused by war.

11. The future of industrialism, both in its internal and its international aspects, is in part limited or fixed by natural factors which can now be stated with some approach to exactness and over which we have little control. But it is also subject to the action of purely human factors, and is to that extent within our control. The question of future growth, and of future peace, both within the nation and between the nations, depends very largely upon the manner in which that control is applied.

The preceding statements are made, not as having been definitely proven by our study of the historic growth of industrialism, but as having been at least suggested by that study. They raise, it will be seen, questions which demand more detailed examination, in the hope that we can reach conclusions regarding some of them at least — conclusions which will be both more definite in form and of broad general validity. These matters which relate to the causes, the effects and the future of industrialism will accordingly be discussed, in the remainder of this volume, in the following order:

PART II. THE MATERIAL BASES OF INDUSTRIAL GROWTH.

PART III. THE CAUSES AND EFFECTS OF GROWTH.

PART IV. THE FUTURE OF INDUSTRIALISM.

PART II

THE MATERIAL BASES OF INDUSTRIAL GROWTH

CHAPTER VIII

THE MATERIAL BASES OF CIVILIZATION

In the preceding section the history of industrial growth has been briefly discussed, in each of the leading industrial nations, up to the time when the World War forced large readjustments in competitive conditions. The development of industrialism was, however, treated merely from its external aspects, without attempting to more than suggest the material and human bases on which such development depended. It will therefore be profitable to turn to this side of the subject, and endeavor to get some more definite idea of the factors which condition the growth of modern industrialism, and which tend to determine the possibility of its existence, the rate of its growth, and the extent to which such growth can be carried, in different countries. These last three words are important, for it will be seen later that not all countries are susceptible to the development of a machine civilization of the type to which we have become accustomed here and in western Europe.

It has been seen that during the past century and a half there has been a great change in the character of the world's industrial activities, a change which in some countries has been so marked, and so rapidly accomplished, as to fairly merit the term Industrial Revolution. This change has not only effected a large increase in the production of commodities, and in the average wealth and standard of living of the inhabitants of industrial countries, but it has affected the structure of industry itself. In doing this it has gradually done away with an older system of small-scale production, where an individual or a small group of laborers produced commodities by hand, and replaced it by a system of large-scale production, where large groups of laborers

produce commodities by machinery. The introduction of machinery was, indeed, so characteristic a feature of the new industrialism as to induce a French writer [1] to coin the word *machino*facture, to distinguish the new industrial period from the older time of *manu*facture. And it is a favorite rhetorical trick of writers and orators of the more radical groups, protesting against what they consider the exploitation of the wage-slave by the new industrialism, to speak of our present *machine civilization.* This latter term is really very good, and can be adopted without hesitation. There is not the slightest reason in the world for us to feel ashamed of the fact that to-day machinery is doing hard and difficult and dangerous work which would otherwise have to be done by men.

We may therefore accept the fact that to-day we are living in a Machine Civilization, as compared to the Hand Civilization of earlier periods. It is the general introduction of machinery, into a very large and increasing number of industries and human activities, which has made possible the type of civilization with which we are now best acquainted. The machine has not only made it possible to produce commodities in large quantities, but it has tended to reduce the cost, per unit, of making these commodities. These two effects, taken together, have increased the wealth of the world per capita, and along with this, proceeding from equally natural causes, there has come about a more equal distribution of this wealth, with a higher wage standard and a higher average standard of living. Modern industrialism has not remade man; it has not changed his intellect or his heart, but it has offered him greater safety and comfort in his life, and wider opportunities for development.

Along with these advances in sheer creature comfort, there have come others in higher lines, which can be attributed in part at least to industrial progress. Science has

[1] Bollet, D., "L'evolution de l'Industrie." Paris, 1914.

gone hand in hand with industry; its theories have now opportunity for immediate application; and in partial repayment of this aid, industrialism offers science new and better tools with which to work, and broader opportunity for experiment and observation. As science becomes increasingly exact and quantitative, both in its observations and in its deductions, its dependence on industry and its aids to industry become increasingly close and important.

In following out this line of thought we have not, in reality, strayed away from our immediate subject as far as might seem, for when we come to examine closely that subject — the material bases of modern civilization — we will find that it is thanks to modern scientific development that we can offer at least approximately precise answers to the chief questions which present themselves. If it had not been for the wonderful advances made by such sciences as geology and chemistry during the past century we should be entirely unable to form any definite ideas as to the real extent of our chief material resources, or as to their probable duration. And these two matters are, in all truth, the chief factors which will tend to fix the direction, and in the long run to limit the growth, of our present type of Machine Civilization.

We are interested in the effects of modern industrialism on the lives and fortunes of the peoples, in war and in peace. Now, when we come to examine the bases on which this modern type of civilization rests, it is seen that the story of industrial growth and competition since 1775 or thereabout is chiefly though not entirely the story of coal and iron. It is true that political and economic growth and predominance were not always expressed in terms of coal and iron tonnage; it is equally true that in the future they may again be expressed otherwise. The facts as to the remoter past and the possibilities as to the more distant future can serviceably be stated and suggested in the later course of the present discussion. But for the most part, as

dealing with the recent past, the present and the immediate future, we must still lay greater stress upon the two material factors which are now the things of chief importance — and these are the existence, and the unequal distribution over the earth, of vast supplies of coal and iron ore.

These two factors have not only made modern industrialism possible, by affording supplies to its machinery — fuel to its engines and metal with which to construct both the engines and the tools — but they have also tended to concentrate industrial development in certain more favored regions. In so doing they have repeatedly changed the balance of power throughout the world, and their effects in this direction are, as we will see later, not yet finished. There have always been differences in the size and population and strength of nations, but these differences have been accentuated by modern industrialism, and they are now very definitely related to certain natural and material causes. Study of these matters goes far toward explaining our recent and current economic and international history, but it also aids us in forming some idea as to the future course of events both within the nation and between the nations.

This recognition of the basal importance of coal and ore supplies does not, however, mean that attention must be limited to their consideration, exclusive of other factors in the problem. We can not get very far by study of a single industry, no matter how important that industry may be, and it will be found when industrial development is examined critically that many other factors share in bringing about the final result. These factors are of various types: they include obviously such matters as changes in population, both as affecting manufacturing ability and markets, increase in the food supply, the increased or decreased production of the precious metals, and others of less broad importance. But in addition to these we must also recognize that there are certain other factors, of widely different type, which have operated to incite or aid or limit

industrial development at different times and in different countries. Among these we may profitably refer to the progress of science, of invention, and of geographic discovery, all of which have certain effects on industrial progress.

In later sections the factors last noted will be taken up in some detail, but at present attention will be confined to consideration of the chief material factors which have influenced the course of modern civilization, as expressed in industrial development. The most important of these are, of course, coal and iron ore; but there are a number of other raw materials which are not of such direct primary importance, but which serve as the bases of various industries. These will be discussed in turn.

Regarding all these material supplies, we are interested in several phases of the subject. At the outset, some idea must be gained as to the known existing reserves of these raw materials, and as to the probability that these reserves will or will not be increased by further discoveries. This naturally brings up the question as to the rate at which we are now using up these resources, the probability as to future changes in this rate of exhaustion, and consequently the probable duration of our supplies. But now another point of interest is suggested, for in the course of our study we will have found that the known supplies are not distributed evenly over the earth, but are on the contrary very much localized, so that certain countries or parts of countries will have large coal and iron resources while others will have little or nothing. This leads us to consider the effects which such localization of our chief resources has had upon the industrial growth of different countries, and as to the way in which it will affect the world competition of the future, whether that competition be commercial or military. Finally, recurring to purely domestic matters, we come to a question which in the United States as abroad is likely to be one of the important political problems of the immediate

future. It involves consideration of the manner in which the great mineral resources are now owned and operated, and of the question of state ownership or " nationalization " of such resources.

It will be seen that the field of study, even if we limit it more or less definitely to coal and iron, is still broad enough; and that unless we can manage to subdivide it, and keep discussion within the boundaries so established, there will be great danger of becoming lost in a hopeless maze of facts and theories. So, to lessen this danger, the chapters which immediately follow — that is to say, the remaining chapters of Part II — will be devoted to consideration of the known resources of coal, iron ore, and other raw material supplies; and of the probable duration of these supplies, considered *en masse*. The questions, international in character, which arise from the localization of the great resources, and their effects on world competition and war, will be discussed in a later section (Part IV).

For the sake of clearness, it may be well to note that the subjects treated in the present section will be taken up in the following order:

Chapter IX. The Coal Resources of the World.
Chapter X. Petroleum, Gas and Water Power.
Chapter XI. Iron Ore Reserves of the World.
Chapter XII. The Supply of the Precious Metals.
Chapter XIII. The Minor Commercial Metals.
Chapter XIV. Chemical and Structural Materials.

CHAPTER IX

THE COAL RESOURCES OF THE WORLD

Coal, as the principal material factor in industrial development, affects both industrial and social progress in numerous and often complex ways. Its effects upon the early history of modern industrialism have been referred to briefly in previous chapters, but it will now be necessary to examine its economic relations more closely, before going on to the questions of the extent and duration of our coal supplies. Only if we understand clearly just how far-reaching are the effects of cheap coal supplies can we appreciate how great are the effects of the geographic localization of such supplies, and how revolutionary would be the effects of their exhaustion.

The uses of coal. Of a given quantity of coal in the ground, a very large proportion, ranging from a quarter at the best to a half at the worst, will be left as pillars, or otherwise lost or wasted during mining operations. This fact must be borne in mind when consideration is given to the exhaustion of coal supplies.

Of the remaining coal, which is actually extracted, a certain proportion also fails to reach the market, being employed in running engines for pumping, hoisting, etc., at the mines themselves. This proportion may amount to five per cent. of the total coal extracted. The remainder is now left as marketable, in one form or another, and for one of many uses. The quantity of marketable coal thus amounts to from 45 to 70 per cent. of the total coal that was originally in the ground. As a fair average, taking in all kinds of mines and all types of coal, it may be assumed that about two-thirds of the total coal in the ground finally reaches a merchant use. We are now concerned with the destination of this two-thirds.

The largest uses, in most coal producing countries, are for power in manufacturing plants, for heating houses and other buildings, and for locomotive service. Next to these in importance come the utilization of coal for steamer fuel, as blast furnace fuel (in the form of coke), and as a raw material itself in the manufacture of illuminating gas and by-products. In considering any given country we would have of course another and in some cases very important disposition made of part of its coal output — i.e., by exporting it to another country. But since the coal so exported is finally utilized somewhere in one of the ways previously noted, the export of coal can not be considered as a separate mode of coal utilization, but merely as one mode in which the coal output of some given country is marketed.

With these facts as a basis, we may say that coal appears as a factor in the world's industrial and commercial structure in the following principal ways:

1. As a fuel used to develop power for domestic manufactures.
2. As a fuel used to develop power for domestic transport.
3. As a raw material, used in manufactures.
4. As an export commodity, and as the fuel used in export trade.

Used in any of the ways noted above, coal produces powerful effects upon the industrial and commercial relations of the producing country, and these effects are so different and so far-reaching that it will pay to consider separately, though briefly, the different modes of utilizing and marketing the coal supply.

Coal as fuel. A large proportion of the coal used in the world is utilized for the purpose of developing power for running manufacturing plants. Whether the coal is used raw, or in the form of producer-gas; whether the steam power developed is used direct, or after conversion into

electric power — these do not affect the main question.

At the time of the Industrial Revolution in England, this use of coal as a fuel for manufactures was looked upon as its chief future utilization, and it is still an important use, and one which affects directly the general manufacturing standing of the country. It is still the chief and most important utilization, though we have come to use larger and larger quantities of coal each year for the simple purpose of transporting commodities and people.

One factor which is often overlooked, but which has an immense industrial and social effect, is the aid given by cheap coal to the development of transport within the producing country itself. Use of coal for this purpose has been a leading utilization of coal for many years in the United States, and despite the increased use of petroleum and electric power for transportation purposes, the same fraction of our coal supply is likely to be devoted in future to the same end.

In its effects on manufacturing, through giving cheap modes of transport, coal is little if any less important than in its direct use as a manufacturing fuel. For the United States indeed, with the vast distances which we have always to consider in producing and marketing a product, the transport use of coal is one of very serious bearing on our industrial situation.

Coal as a raw material. When coal, particularly a bituminous coal, is heated strongly out of contact with air it is not burnt, but distilled, and in the process of this distillation several groups of products are formed. The fixed carbon and ash which were in the original coal remain, of course, in the form of coke; but in addition the more volatile constituents of the coal separate out in the forms respectively of gas, ammoniacal liquor, and coal tar. Of the four classes of product made by distilling coal there are three — coke, gas and coal-tar — of great individual importance, and at various times and various places each of them has

been the product most desired. This fact serves to complicate the commercial questions involved, for of course we can look at the matter from each of these separate viewpoints. To the manufacturer of illuminating gas, the coke, tar, etc., are all by-products, and the gas is the main product. To the iron industry, the coke is the main product, and the others were, until quite recently, wasted. In the future it is possible enough that the coal-tar will be the main product, and that the gas and coke incidentally produced will be looked on as the real by-products.

Historically, coke was the first coal-product to be made; after this came illuminating gas; finally came the coal-tar derivatives. As has been noted in an earlier chapter, coke for furnace use was first made in the seventeenth century, and was widely adopted in England in the eighteenth. Illuminating gas, on the other hand, was not made for use until 1798, when the first private gasworks was constructed for an English factory. Public gas works came a little later, from London in 1813, to Paris 1815 and Berlin 1826. During the first half of the nineteenth century the use of blast furnace coke grew rapidly, as did the manufacture and use of illuminating gas; but in both the coke ovens and the gasworks the coal tar was practically wasted. It was not until 1856, when Perkin discovered the aniline colors which could be produced from coal tar, that any serious attempt was made to utilize this product, though small quantities had been treated previously in order to make benzene and illuminating oils, from which latter practice arose the term "coal-oil" so frequently still applied to kerosene in certain parts of the country.

The manufacture of aniline dyes and other coal-tar products spread rapidly, Germany soon taking the lead in this line of activity. In the United States, until the war cut off the foreign supply, little was done in this direction. The first American by product coke ovens were erected in 1892, and their use extended rapidly, so that in 1913 over

one-quarter of our total coke supply was produced in by-product, as distinct from bee-hive ovens. But the chief by-products, so far as value were concerned, were still the ammonia and the gas. It will be of interest to note that in the year preceding the war some twelve million tons of coke were produced here in by-product ovens; and that the total by-product values were respectively six million dollars worth of gas, almost eight million dollars in ammonia products, and less than three million dollars in coal-tar.

Relative importance of uses. The data do not exist for giving an exact statement as to the relative amounts of coal used for different purposes, but we do have figures for the uses in the United States during recent years, broadly grouped; and with these as a basis we may get a sufficiently accurate idea as to world conditions.

Taking a year before the United States had entered the war, and in which industrial conditions were not far from normal, the figures given by the United States Geological Survey for anthracite and bituminous utilizations during 1915 are as follows, when reduced to metric tons:

	Metric tons	*Per cent. of total*
Coal used at mines for pumping, etc...	18,000,000	3.9
for locomotive fuel	118,600,000	25.6
for manufacturing power ..	147,900,000	31.5
for heating buildings	110,300,000	23.8
for making coke	56,200,000	12.1
for illuminating gas	4,200,000	0.9
for steamer fuel	9,800,000	2.2
Total.....	463,000,000	100.0

The figures above given may now be used in relation to the world output of coal, which during the last year of great production (1913) amounted to about 1,344,000,000 metric tons. As further bases we have the facts that America had at that time about one-fifth of the world's steam

shipping tonnage; almost two-fifths of the railway mileage; the same proportion of pig-iron output; and certain rather well known habits as to over-heating houses and over-pushing engines and furnaces.

Making rough allowances for the factors above named, we get results about as follows, for the uses to which the world puts its coal, excluding the portion used at the mines;

		Per cent.
Manufacturing purposes.....	562,000,000	43
Heating buildings.....	250,000,000	20
Locomotive fuel.....	230,000,000	18
Coke	150,000,000	12
Steamer fuel.....	75,000,000	6
Illuminating gas.....	12,000,000	1
	1,279,000,000	100

The results are not of course precise, but so far as known no previous estimate of this sort has been made, so that they will have to be accepted temporarily. They indicate that a little over half our coal supply goes to the making of new commodities, and about a quarter to the task of transporting these commodities to market; while the remaining quarter is utilized for human comfort directly.

Coal as an export commodity. Countries or regions which have a coal-output in excess of that currently needed for local uses can of course export coal, like any other commodity, provided they can reach a market profitably. If their own supplies are dear, because of mining costs or transportation difficulties, their export trade in coal will be small or entirely lacking. But if the local coal is cheaply mined, and especially if the mines are near the seaboard so that transportation to ports is cheap, then the export trade in coal may attain very great dimensions. The country most favored in this regard has been Great Britain where both the necessary conditions have obtained.

Now, if we look upon the export trade in coal simply as a means of exchanging a commodity for money, it is one of the worst possible trades that a country can enter upon. It does not bring in any remarkable total profit, or profit per ton. Furthermore, and this is of more importance; we are selling a commodity than can not be replaced, but on the contrary grows naturally scarcer each year, so that in the long run our own manufacturers will have to pay, dearly enough, for every cent that has been made out of the coal export trade. A nation which exports coal is not really selling anything; it is draining itself of its life-blood.

Looked upon solely as a merchantable commodity, coal is therefor the most expensive thing we could possibly export, except men. But there are certain collateral advantages connected with the export of coal, which go far toward counter-balancing the great disadvantage. In the long run they fail to do it, but they are so impressive that they cover up the loss for a long time, and give an appearance of great prosperity and wealth, so long as the supply of cheap coal lasts. When it fails, or when some competitive nation develops still cheaper coal, the realities of the case stand out sharply. An export trade in coal which is carried to such a point as to make serious inroads on the supply is not a sound commercial or political proposition.

As for the counterbalancing advantages, they arise through the use of coal as a transport fuel, and they operate in very broad fashion. For example, if a certain tonnage of coal be shipped abroad, another small but still considerable tonnage will be used to take that same ship out and bring her home. But she will not come home light, but laden with foreign products. A coal shipment therefore brings about not only further use of coal, but increased foreign trade. In a country whose manufactures have overrun her agriculture, coal exports may be an important means of paying for and bringing home foreign food supplies.

Still more important commercially and industrially are the consequences which arise, not directly from the export trade, but indirectly from one of its natural results. In a country handling coal exports there will be almost inevitably ample coal supplies and good bunkering facilities at its ports. There is a direct inducement for shipping, foreign as well as domestic, to make one of the ports of a coal-producing country as an intermediate stop in a long voyage. The end result of this process is that the coal-producing country is likely also to become an important re-handling country, for all sorts of foreign products.

Finally, since cheap coal supply is an important element in cheap operation of shipping, there will be a tendency for the shipping interests to become domiciled in a great coal-shipping country. In that way the profits incidental to a merchant marine will also come to the coal country — not only these gained by direct shipping operations, as freights and wages and insurance, but also those derived from the building and sale of ships.

The total effects of using coal as a transport fuel in the export trade are so great that we might fairly replace the old and partly untrue saying that trade follows the flag, by one more wholly true — *trade follows the fuel.*

THE EXTENT OF THE COAL SUPPLY

Coal is widely distributed throughout the world, and occurs in greater or lesser quantity on all the continents and in many countries. But, as will be later found, it is by no means evenly distributed from a geographical or national standpoint, and this fact has had and will have great economic and political effects.

At present, however, attention may be confined to the matter in its most general form — the total supplies of coal which are known to exist. On this point we are aided by national fears and hopes, which have operated to secure the

data necessary for forming any sound conclusions on the subject. For almost a century Great Britain has been much concerned, at intervals, over the impending exhaustion of the British coal supply, and a series of royal commissions have at various times investigated the subject, with differing results. Later, as Germany began its great industrial expansion, that country was troubled in similar fashion regarding its own coal reserves. Still more recently the United States, equally agitated though with far less reason, exhibited a similar apprehension concerning the extent and the probable duration of the American coal resources.

From our present standpoint, the immediate and very useful consequence of those fears has been that, for some years past, there have been available very detailed data concerning the coal resources of the three great competitive industrial nations — the United States, Germany and Great Britain. But with regard to other countries the information has, in general, been more or less fragmentary and incomplete. This deficiency in our industrial knowledge was the more serious in so far as it raised uncertainties concerning the exact coal situation in such countries as China, Canada, Australia, India and South Africa — the countries which might be expected, on one ground or another, to furnish competition to our own manufactures when the gradual exhaustion of British and German coal resources begins to limit the further growth of our European competitors.

Immediately before the World War, however, these deficiencies in our knowledge were made up in very generous fashion, for a detailed series of reports, covering the coal resources of almost every country in the world, was prepared at the instance of the Twelfth International Geological Congress and published in 1913. It was fortunate that this great coöperative work was taken up and finished at that particular time, for obviously any later discussion of such matters as German and Chinese coal reserves would

be looked on with some suspicion, as possibly affected by political considerations.

The data presented in these volumes will be used as the basis for the further discussion of both total and national coal supplies, and except where specific statement to the contrary is made, they will be used exactly as published. Considerable rearrangement will, however, be necessary in order to suit our present requirements.

The world's total reserves. At the outset, in order to get a broad view of the entire situation, it will be well to summarize the data given as to the total coal reserves of the world. This is done in the following table, where the total is given, classified further by continents and by kinds of coal.

ESTIMATED COAL RESERVES OF THE WORLD, IN MILLIONS OF TONS

Continent	*Anthracite*	*Bituminous*	*Lignite*	*Total*
North America	21,842	2,239,683	2,811,906	5,073,431
Asia	407,637	760,098	111,851	1,279,586
Europe	54,346	693,162	36,682	784,190
Australasia	659	133,481	36,270	170,410
Africa	11,662	45,123	1,054	57,839
South America	700	31,397	.....	32,097
World total, millions of tons	496,846	3,902,944	2,997,763	7,397,553

The first impression that will be made by this table is, of course, that the coal reserves of the world are tremendous, as compared with existing human requirements, and that therefore the fear of coal exhaustion must be too absurd to require any careful consideration. This viewpoint might be supported by noting that in 1913, the year at which world coal output reached its maximum, the total produced all over the world amounted to slightly less than 1500 million tons. At this rate of consumption, large though it is, the coal supplies as above tabulated would

last for some 4500 years. On this basis there would obviously be no reason to give the matter any serious thought.

The question of exhaustion. There are, however, two very serious objections which may be urged against taking such a very optimistic view of the question. The first is, that the annual coal requirements of the civilized world are increasing at a very rapid rate, and that for a long time to come we may fairly expect this increase in yearly output to continue, even if the rate of progress is lowered somewhat. We will see later when the rate of industrial progress is under discussion (Chapter XXII), that for sixty years or so the world has used on an average, four per cent. more coal each year than in the year preceding. This is equivalent to an eight-fold increase in a half-century. It implies that during our next period of industrial activity we will rise far above the record established during 1913. To put the matter more precisely, it is entirely probable that during some boom year in the next decade, say around 1925 for example, the world will produce coal at the rate of 2200 million tons a year. Continued as far even as 1950, the recent rate of progress would imply a world output in that year of some 7500 million tons. And it will be seen that now we are reaching figures which would have a very appreciable effect on the total supply. Continued to the year 2000, we reach a theoretical annual consumption of 50,000 million tons. If we keep up this arithmetical exercise we would see that it implies the total exhaustion of all the world's coal supplies in about two hundred years.

But this sort of thing, though it may be a pleasant sport for children or statisticians, does not in reality get us anywhere, for all these forecasts as to the future are based on continuation of the present rate of growth in annual demand. Now, when we come to consider the causes of industrial growth, we will see that there is every reason for believing, on the contrary, that this rate of growth will not

continue, but will fall off markedly; and that there are some reasons for expecting the decreased rate to show itself very soon. And when I say very soon, I do not mean the year 2000, but within ten or twenty years from now. If these conclusions are correct, we need not trouble about actual exhaustion of our coal supplies. The real grounds for concern are somewhat different. They relate to the character and cost of the coal which we shall have to use, and to its unequal distribution over the world. Both contain possibilities of trouble, both within the nation and between competitive nations.

Character and costs of future coal. When the table of world coal reserves was presented, it was noted that it included coal of various grades, ranging from the best anthracites and bituminous coal down to some brown coals and lignites that are pretty poor apologies indeed for fuel. If it is ever necessary to really use as fuel some of the material that is included in these estimates it will be a very difficult world indeed for both laborer and engineer, and still more difficult for the innocent bystander.

It may furthermore be added that in addition to including some very poor fuels, the table includes coal beds some of which are so thin or so impure as to be commercially valueless to-day. Moreover, much of the total reserves as tabulated are in coal beds lying at depths, up to 6000 feet for example, greater than are now profitably worked. And a final allowance must be made for the fact that a certain proportion of the known supply is so located geographically as not to promise relief for any existing or proximate commercial and industrial necessities.

To make exact and proper allowance for all of the factors which enter into the problem of coal grades in our reserve supply would be of course impossible, and it would require a large amount of very detailed information before even a close approximation to the truth could be reached. If we

were making a careful comparison of the competitive status of two given countries it might pay to make the attempt, but for our present purposes it will be unnecessary. By making some very rough deductions from our previous table we can arrive at results which are close enough for the uses to which they will be put.

In doing this, we can start by deducting all the reserve tonnage of brown coals and lignites. It is true that these coals are mined even now in many localities, and that their use will undoubtedly increase as the higher grade coals become dearer; but under existing industrial conditions they can never furnish a very high percentage of the total fuel requirements. So far the present calculations, which postulate a world of about the current industrial type, the anthracite and bituminous coals alone need to be considered.

A second series of deductions should logically be made to dispose of the coals described in the various reports as being very thin, or under very heavy cover. These will also reach market in the future, but not in any large quantity except at a great increase over normal costs. These deductions, which of course are subject to large possibility of difference of opinion and errors of judgment, would make quite large reductions in the tonnages reported for several European countries, but would leave those reported for the United States and China unchanged. Under these circumstances there will be no need to make them, since they can have little influence on future competition.

If then, we consider only the anthracite and bituminous coals, we get even figures about as follows, which represent approximately the tonnage of high grade fuels still available. The figures given on page 112 are in units of a thousand million tons.

Perhaps half of this tonnage is so located as to be mined without over-great difficulty, but even after making this

large allowance for deep-level coals we have remaining over two million million tons.

North America	2260	thousand	million	tons
Asia	1170	"	"	"
Europe	750	"	"	"
Australasia	135	"	"	"
Africa	55	"	"	"
South America	30	"	"	"
World total.....	4400	thousand	million	tons

This total may, I think, be accepted as a reasonable estimate of the high-grade coal still available for the use of the world, at moderate depth and under ordinarily expensive working conditions. It is admittedly based upon data of very variable value, but the differences as to thickness, depth, location, etc., are of such a character as to give a fair average for the total estimates. It is obviously a total stated in vast tonnages; it implies that there is a thousand years' supply at the present rate of output; and that even if the world's rate of coal consumption increases in future as steadily as it has in the past, it will be several hundred years before the better grades of coal disappear from use. Regarded merely as a total, the effect is reassuring. There are, however, other aspects of the matter which are worth further study, for when we examine the manner in which this total reserve is distributed geographically it becomes evident that serious shifts in the location of the greater manufacturing industries may fairly be expected at no very distant date.

The Geographic Distribution of Coal Reserves

Having discussed, briefly at least, some of the more important general points regarding the world's coal reserves considered as a whole, it is now possible to turn to a matter still more important, in its bearing on industrial develop-

ment and on past and future international relations. This is the manner in which the known coal reserves are distributed geographically, and the extent to which different nations are the possessors of these reserves. It will be seen immediately that the distribution, both geographic and national, is very uneven indeed. The fact that such inequalities exist is currently recognized, but the extent and the effects of the inequalities are not so commonly understood.

For the sake of clearness, it will be well to take up the question geographically, by continents, in the order of their coal importance as indicated in the preceding table. That involves consideration of the continents as follows: North America, Asia, Europe, Australasia, Africa and South America.

North America. Of the 4400 thousand million tons of high-grade coal reserves, North America accounts for 2260, or more than half of the world's total supplies. Of this little or none exists in Mexico or the states of Central America, and only a relatively small tonnage of doubtfully utilizable coal in Newfoundland. The large tonnages are in the United States and the Dominion of Canada, and these two nations are supplied as follows:

United States	1975	thousand million tons
Dominion of Canada.....	286	" " "

The United States has therefore almost exactly 40 per cent. of the world's supply of coal, and Canada about 7 per cent.

Asia. Asia ranks second of the continents so far as coal reserve is concerned, having some 1170 thousand million tons, or about a quarter of the world total. The distribution of the Asiatic reserve is even more localized than that of North America, for China accounts for almost all of it. The figures regarding the leading Asiatic countries are shown on page 114.

China	995	thousand	million	tons
India	79	"	"	"
Siberia	67	"	"	"
French Indo-China	20	"	"	"
Japan	8	"	"	"

The Chinese reserve is therefore about five-sixths that of all Asia, or a little over a fifth of the total world supply. China and the United States together account exactly over two-thirds of the world's reserve of high-grade coal, a fact which must always be taken into account in considering the trend of industrial development in the future.

Europe. Third in rank among the continents as a possessor of coal, Europe has remaining some 750 thousand million tons, or about one sixth of the world's reserves of high-grade fuel.

Prior to the World War, the figures for the distribution of this European total among the different nations were as follows:

German Empire	410	thousand	million	tons
Great Britain	190	"	"	"
Russia in Europe	58	"	"	"
Austro-Hungary	45	"	"	"
France	16	"	"	"
Belgium	11	"	"	"
Spain	8	"	"	"
Holland	4	"	"	"

The remaining small tonnages are scattered widely among the smaller states. From this it will be seen that at the outbreak of war the German Empire covered about one tenth of the world coal supply, ranking third to the United States and China. But in considering the future of Germany and the other European powers, it must be borne in mind that the peace treaty brought about a sharp readjustment not only of iron ore reserves but of coal reserves. The former question has been noted on a previous page (p. 85); and both will be recurred to in more detail in

a later chapter, when the future of world competition is under discussion.

Australasia. The three continents already discussed are the coal-rich areas of the world, for North America, Asia and Europe contain over nine-tenths of the total fuel supply of the world. The three which remain to be discussed are not only relatively but absolutely deficient in coal.

Among these three, however, there are wide differences in degree of poverty. Australasia, for example, contains some 135 thousand million tons of coal, or two-thirds as much as Great Britain, and since the bulk of this tonnage is concentrated in the British possessions, there is the certainty that industrial development will have a sufficiently great fuel basis to become important. Of the total credited to Australasia, practically all is in Australia, and 118 thousand million tons of it is in New South Wales.

Africa. The relatively small known coal reserve of Africa is similarly concentrated in British possessions, for of the total of 56 thousand million tons credited to the whole continent, all except a trifling amount are in South Africa.

South America. Poorest of all the continents in coal supplies, even the small tonnages credited to South America are so located as to have little influence on trade or industry. Of its 32 thousand million tons of coal reserves, 27 are in the mountainous region of Columbia. The Chilean supply, small in reserve however, is the only South American coal which has even a small effect on the commerce of the world.

The coal situation; summary. The preceding pages have placed before the reader the chief facts, necessarily in very brief form, relative to the coal supplies of the world. Our interest in the matter lies, of course, in the bearing of these facts on the questions of present and future industrial development in the various countries, and in its future effects on world competition and leadership. These matters we

will recur to later, in Chapter XXIII. At present it will be well to summarize the main facts brought out so far. They seem to be about as follows:

1. The coal reserves of the world are known to be very large, even as compared to a future increased demand. The period before which any trace of general exhaustion need be feared is to be measured, even from the most pessimistic standpoint, in centuries.

2. As demand continues, however, we are steadily using coal of a little lower grade, and coal that is a little more difficult and expensive to mine. These facts have a direct bearing on future coal costs and on future manufacturing costs in other lines.

3. The coal supplies of certain manufacturing districts and of certain countries are further advanced toward exhaustion than are those of some existing or possible competitors. There will therefore be seen changes in relative importance of manufacturing centers, and gradual but certain changes in kinds of industry practiced.

4. In the very near future it is probable that the entry of new continents into the industrial field will make still greater changes in manufacturing, in world competition and in world leadership. These may bring about changes in social and industrial structure among the older nations, especially among those most hardly pressed by their own decreasing coal supplies and by the new competition.

CHAPTER X

PETROLEUM, NATURAL GAS AND WATER-POWER

The three power-producers to be considered in the present chapter, unlike in other respects, agree in that they often serve as the basis for vague and not entirely well-founded optimism regarding the industrial effects, in the future, of the decreasing grade and increasing cost of our coal supplies. Whenever any question arises as to the manufacturing difficulties which even now confront some of the leading nations, there is always someone at hand to blandly observe that no trouble about coal supplies need be serious, because oil or water power will replace coal anyway in the near future. It may be worth while to examine this question a little more carefully than usual, in order to get some idea as to the future probabilities in either of these directions. It will be found, perhaps, that wide as may be the applications of these newer agents, they will probably not serve as direct replacers of coal, at least to any large or constant extent. Both water power and petroleum will undoubtedly have important effects on the industrialism of the future, but these effects will be, to a considerable degree, unlike the effects which coal has produced.

Petroleum

Since its discovery, as a commercial product, just before the Civil War, the production and utilization of petroleum have been kept before the public mind so steadily, for one cause or another, that we are likely to over-estimate both the present industrial importance of the mineral oil industry, and the probabilities as to its continued growth and increase of supply.

As regards the first point, it is still safe to say that if the

entire petroleum supply of the world were to be cut off completely to-day, it would mean that we would have to increase our coal mining some eight per cent. at the most to replace the missing product in technical efficiency. What would actually happen in such a case would be that the coal output would increase only four or five per cent., and that the balance of the deficit would be made up by distillation of shales, to get not petroleum but its derivatives.

The second point raised — the duration of the petroleum supply — is of more immediate practical importance. The case seems to be that we are here dealing with a mineral resource whose annual output is already excessive, as compared with the known or probable remaining supplies in the earth. That is to say, we are using up a far larger percentage of our total petroleum reserve than of our coals or iron ores, for example. This is partly brought about by the cheapness with which oil wells can be sunk and heavy production brought in, and the consequent tendency to flooding the market during bad times. It is likely to continue at a constantly increasing rate unless some degree of community of ownership puts a stop to excessive development. Barring some such future regulation of the industry, we are likely to see petroleum produced in increasingly large quantities, even during periods of very low prices, so as to form a heavy draft against what is really a very small total supply in the ground. Our children will in all probability see the end of the petroleum industry.

Growth of the oil industry. The existence of petroleum has been known for centuries, and it was used to a small extent in many countries prior to the great commercial development of the past sixty years. But as the basis of a real industry, its history goes back only to a few years before our Civil War. In 1857 Roumania first shipped petroleum, and in 1859 the first well was sunk in Pennsylvania. The published data give a world total of less than 510 thousand barrels in 1860, of which 500,000 are credited to the United

States. In considering these and later figures, it will be well to recall that the barrel of crude petroleum contains 42 gallons, while the barrel for refined oils contains 50 gallons.

By 1870 Canada and Russia had entered the producing list, but the United States still produced over five million barrels, out of a world total of less than six million. The next decade saw the entry of Galicia, Japan and Germany, and a world total of thirty million barrels in 1880, of which over 26 million were the output of the United States, By 1890 the total had risen to 76 millions, of which 46 were derived from the United States and 29 million from Russia, no other country producing as much as one million barrels.

In 1900 the world total was 149 million barrels, Russia leading with an output of 76 million and the United States taking second place with 64. It may be noted that in the following year, 1901, Russia reached her maximum output to date, producing over 85 million barrels, since which the falling off has been quite steady. By this time the original producing list had been swelled by the addition of India, the Dutch East Indies and Peru, all of which were later to become quite important producers.

In the year before the war, 1913, the world produced 385 million barrels of petroleum. Of this total, the United States' output was 248 million barrels, almost two-thirds of the entire world supply. Russia was second, with 63 million barrels, and Mexico a very bad third, with 30 million barrels.

The totals for growth by decades, which have just been given, are more illuminating when we use them as a basis for calculating the rate of growth. The table on page 120 shows the percentage of increase during each decade from 1860 to 1910.

Assuming that the rates for the three later decades may represent fairly the average, after the first sudden expansion had taken place, we have a rate of 123 per cent. per decade,

1860–1870	1030	per cent.	per decade
1870–1880	420	"	"
1880–1890	155	"	"
1890–1900	95	"	"
1900–1910	120	"	"

equivalent to only a little less than ten per cent. annually. This is twice the current rate of growth of the coal and iron industries of the world, but because of the fatal ease of its extraction petroleum may be expected to keep up a relatively high rate of growth for another decade or two at least. After that, unless our present knowledge of petroleum supplies is fatally defective, we may expect to see a lower rate of increase, due to scarcity of supply.

The occurrence of petroleum. So far we have accepted the occurrence of petroleum in the world's markets as a normal trade product, without inquiring too closely into the question of how it comes to reach these markets. But before discussing its treatment and utilization it may be well to pay some attention to its mode of occurrence, for it will be found that this exerts powerful effects on the characteristics of the petroleum industry.

In doing this there will be no attempt to consider the finer points of difference in scientific opinion, for few of these have any bearing on our immediate problem. We will merely accept the fact that petroleum is a natural mineral oil, derived originally from marine deposits — sands, clays, etc.— which contained abundant animal or vegetable remains. These deposits, later buried under other beds of rock, have been for long periods subjected to the heat and pressure of the earth's crust, and portions of the original organic matters contained have been distilled off to form the petroleum which we use to-day.

Earth movements have aided, not only in the formation of the oil, but in its present concentration, and have to some extent at least determined its present areas of accumulation.

When the prospector's drill finally encounters petroleum it does not do so by breaking into an underground lake or pool or stream of oil, as is often supposed by naïve speculators in oil stocks, for such free underground accumulations of petroleum do not exist. The drill merely enters a stratum or bed of rock, usually sand or sandstone or limestone, in which petroleum fills the spaces or pores between the grains of rock. The occurrence is entirely comparable to the condition in which underground water is found by a well.

The petroleum, once found, may be forced to the surface naturally by gas pressure, or it may require pumping almost from the start. The flow per well may be large, as often illustrated in newspaper reports, or small, which is the commoner occurrence. The oil may be a light oil, or a heavy poorer grade oil. The field, as outlined by later drilling, may be small, or it may cover hundreds of square miles. All of these factors must be taken into consideration in getting an idea of the commercial value or industrial effect of a new oil discovery.

But in any case, the time an oil-field attracts public attention is usually during its first year of really large output, for oil fields have a pretty steady tendency toward reaching a maximum of output very rapidly, and then showing a slowly declining tendency for a greater or lesser number of years until they are finally exhausted.

The great profits of a successful oil area, as well as its rapid attainment of maximum production and its subsequent short life, compared with the results obtained from coal, iron or other mineral ventures, are due substantially to the same cause. That is the cheapness with which oil output can be developed, as compared with the slowness and expense of developing a mining area. A well costs only about one-tenth as much, per foot of descent, as a shaft; and it can be put down in much quicker time. When it is once in

contact with the oil, operating expenses are trifling, for in many cases the oil reaches the surface under natural gas pressure, and in the others it has merely to be pumped. There are not the expenses for breaking ore, timbering, haulage, etc., which are common to all other kinds of mineral development.

These factors make successful oil regions very profitable, but they also tend to make them very short-lived.

Petroleum and its products. Crude petroleum, as it issues from the well, is a liquid varying quite widely in density, color and composition. As to the former point, it may range from a liquid almost as heavy as water, as are the Mexican and Argentine oils, to one only four-fifths as heavy, as are the better grade Pennsylvania and West Virginia oils. As a rule the lighter petroleums will yield a larger proportion of such products as kerosene and benzene, while the heavier oils will yield more paraffine, asphalt, etc. Generally speaking, the naturally light oils yield the higher value of total product.

The petroleum products, of which mention has been made, are derived from the crude petroleum by refining, which is essentially a series of distillations, based on the fact that different products distill off at different temperatures.

An idea of the relative commercial importance of the various petroleum products, grouped broadly, is secured from the following data as to the refinery output of the United States during recent years, the statistics being those collected by the Bureau of Mines.

	1916	*1917*	*1918*
Gasolene, gallons	2,058,900,000	2,850,500,000	3,570,300,000
Kerosene, etc., gallons	1,455,500,000	1,726,800,000	1,825,400,000
Fuel and gas oils	4,663,900,000	6,513,300,000	7,321,400,000
Lubricating oils	624,500,000	753,800,000	841,500,000
Residuals, gallons	239,200,000	702,200,000	1,286,700,000
Wax, pounds	386,200,000	481,200,000	505,100,000
Asphaltum, tons	716,490	739,425	607,968
Coke, tons	405,319	539,366	559,663

The utilization of petroleum. In order to get some clearer idea of the facts regarding this vexed question, it will be well to consider the various ways in which petroleum is utilized in the industry and commerce of the world. These fall, classifying the uses very broadly, into four groups:

First, petroleum or heavy products are used directly as fuel under boilers, in place of coal.

Second, gasoline or some other petroleum derivative may be used as a fuel for internal combustion engines.

Third, kerosene and some other petroleum derivatives are used largely for illuminating purposes.

Fourth, petroleum is used as a basis or raw material for making various pharmaceutical and chemical products.

Now, if we look over this classification, we will see immediately that the question of how far petroleum will replace coal, or compete with it, depends in large part on the particular kind of use we have in mind. Petroleum used as a direct fuel, under boilers, does replace coal directly, more than ton for ton. But when gasoline is used in an internal combustion engine it does not replace coal or compete with it directly, for obviously coal can not be used for such purposes. For the remaining uses — as an illuminant or as a raw material for chemical manufactures, petroleum and its derivatives are almost equally independent of the coal market.

We are likely to overlook these very plain features of the matter, particularly because, during the World War, the demand for oil was greatest along certain directions which may not be the important things after the war.

The basis of petroleum reserve estimates. Fashions change in mining geology as in other lines of human interest and endeavor, though aside from the professional group

who are personally interested in such matters the fact is rarely understood. Twenty years ago the few geologists who applied their scientific training to commercial utilities did so, with few exceptions, along the line of precious metal mining. A decade later, and a widespread activity in copper developments brought along with it a new group of mining geologists, specializing in copper-ore deposits. Within the past ten years the trend has again changed, and now we find a large number of trained geologists handling the prospecting and development of oil properties.

In the earliest stage of petroleum history, the matter of well location was purely a matter of chance, helped along it may be by recourse to divining rods or by the advice of local men. The geology of petroleum was not clearly understood, the conditions which facilitated or prevented its accumulation at any given locality were still less definitely comprehended. Under these circumstances it is not strange that little help was received from geologists during the early stages of the oil industry in this country and elsewhere. A trained man could, it is true, prevent the driller from making certain very obvious mistakes, but he could hardly go further, and give any advice which would yield positive results.

With the development by I. C. White of the anticlinal theory, as applied to oils occurring in the Appalachian and similar fields, the possibilities of scientific help became enormously enlarged. From that time on it was commonly recognized that close and careful study of the geologic structures of a folded region would enable fairly accurate predictions as to success or failure likely to be encountered in certain general regions. Advantage was commonly taken of this fact in well location, but for the moment nothing further could be expected.

As petroleum development spread away from its original center in the Pennsylvania region, the services of geologists were again called into requisition, to face entirely new con-

ditions and to develop broader theories of oil accumulation. The growth of the applied science was slow, and for many years it seemed as if little more help could be expected from geology. The fields of Indiana, Illinois and Kansas were in well-developed commercial condition before any advance could be noted on the theoretical side of the question.

The real opportunity for the petroleum geologists came with the opening of the Texas and, later, of the California and Mexican fields. The oils in these fields were of different type from those found in most of the older regions; and they occurred under considerably different geological conditions. These facts, which at the outset might have been looked upon as handicaps to scientific aid, turned out in the long run to be distinct advantages. A group of men, thoroughly and broadly trained in structural and general geology, but little used to the older oil fields, took up the entire problem *de novo*. Detailed studies produced, at first, few results which could be put to practical service; but persistent attention to the problems involved at last brought about a very decided change in the situation. The practical results have been more surprising than is ordinarily realized. There is still a large element of luck in connection with the drilling of oil wells, but on the other hand there are many important petroleum fields in which estimates and locations can be made with but little less accuracy than in dealing with a coal field or a series of iron ore deposits.

The result, of course, is that all of the large producing companies now carry out geological work for their own account on a very extensive scale. Lord Cowdray's great Mexican success, the Aguila Oil Company, was at first of little promise, and has attained its productive capacity under the careful study of a former chief geologist of the United States Geological Survey, later vice-president of the Aguila company. Another American geologist, also a former member of the Federal Survey, handled the extensive attempt at petroleum development in China carried out

prior to the war by an American corporation. Practically all of the oil development now going on in California, Mexico and South America is under the direct charge of trained geologists, mostly it may be noted of Americans trained in the Gulf and Pacific Coast oil fields.

It would of course be an error to assume that absolute precision and unfailing prophecy are now possible in the oil business. But, on the other hand, it is fair to say that with properly detailed examinations and studies a petroleum development can be placed upon substantially the same basis of accuracy as any other mining operation. And this, it may be noted, is really accuracy of a far higher grade than is suspected by the public. Those who are only acquainted with mining work through the medium of swindler's prospectuses do not realize just how definitely organized a business it can be made when carried out by a large and well-organized staff. There is still wide range of possible error in dealing with a small individual mineral deposit, but even these opportunities for local error will become relatively unimportant when taken as part of an extensive series of observations and estimates on a large group of deposits. In similar fashion the geologist may be unable to foretell the exact results which will be obtained from a single well; but the estimates for a large field will be close enough to the truth to serve as a sound basis for commercial development. The net result, so far as we are concerned at present, is that estimates of the total reserve tonnage of petroleum still remaining in known fields, and of the probable future extensions of these fields, may be accepted with a high degree of confidence. We may now consider what the best of such estimates seem to indicate with regard to the duration and sources of our future petroleum supply.

Chief sources of petroleum supply. Heretofore, as we have seen when considering the growth of petroleum output, the United States has been the world's chief source of petroleum from the commencement of the industry. That con-

dition, however, will not continue always, and we have some reason for thinking that it is even now close to its end. During the past decade five careful estimates have been made and published at different times by different authorities, and all of these agree substantially in their results. Brought up to date, the estimates of Mr. Ralph Arnold imply that at the close of 1919 the oil remaining in the ground in the United States may amount to some four thousand million barrels; the most recent estimate, by Dr. David White, would place the unused reserve at the same date, at less than six thousand million.

What these figures mean with regard to the future of the American supply is clear enough. Accepting the larger estimate, our unused petroleum will last some fifteen years at the current rate of production, or far less than ten years if the production should increase as it has done in recent decades. This means that prices will increase sharply unless some new sources of at least equal importance are found. Later we will note where these new sources may lie.

At present, however, there is another point of interest about the American oil reserve, and this deals with its character. As indicated in the table giving unused oil by fields, almost half of the total American reserve is the relatively low grade oil of the California and Gulf fields, yielding little in the lighter products, such as gasoline. Evidently the light oils will rise more in price than the heavy oils, so far as the United States alone is concerned.

The figures on page 128 have been re-grouped, and changed slightly from the original form in which they were presented by White, in order to make use of the final 1918 production statistics. With the 1919 output subtracted, we seem to have, at the opening of 1920, about 6,350 million barrels of oil remaining in the American deposits. If the United States keeps up its present rate of output, less than fifteen years should see the end of the domestic oil supply.

PETROLEUM RESOURCES OF THE UNITED STATES

Oil field	*Total output 1857–1918 inclusive*	*Output in 1918 barrels*	*Available oil left in ground at end of 1918, bbls.*
Appalachian	1,221,800,000	25,400,000	550,000,000
Lima-Indiana	448,500,000	3,220,000	40,000,000
Illinois	298,200,000	13,370,000	175,000,000
Mid-Continent	1,171,400,000	179,380,000	2,215,000,000
Gulf	306,500,000	24,210,000	750,000,000
Rocky Mountain	50,610,000	12,810,000	750,000,000
California	1,110,200,000	97,530,000	2,250,000,000
Total U. S.	4,607,210,000	355,930,000	6,730,000,000

We are now in position to draw some definite conclusions as to the relative value and importance of coal and oil supplies. In the previous chapter it was noted that the United States had an unmined coal reserve of some 1975 million tons. We now see that its petroleum reserve, converting barrels into tons, amounts to only one two-thousandths of its coal supply. Or, to put the matter in another and perhaps more striking way: If we stopped mining American coal to-day, and let American petroleum take its place, all of our oil deposits would be exhausted in almost fifteen months. It would be well, before becoming too optimistic as to the future replacement of coal by petroleum, to get some idea of actual facts as opposed to cheerful imaginings. We have just as much real chance of replacing coal by oil as we have of finding enough gold to use it in place of steel.

The future of the oil industry. These are unpleasant facts, but they may as well be faced, for the Pollyanna attitude never gets you anywhere in real life. Within a few years the United States will certainly lose its preëminence in the oil industry, so far at least as domestic supplies are concerned — and that is a leadership which it has maintained steadily since 1857. The American oil industry has built up great fortunes, and it has shown some remarkable competitive practices — both of which features have been

discussed to the point of weariness by legislators and journalists. But it also did much to make American life easier, and to spread our commercial influence abroad. It did this long before we were able to export steel products successfully, and fifteen years ago a Standard Oil tanker was about the only freighter carrying the American flag that you would see in a foreign port.

The American refining industry is not doomed to extinction, however, even though the supplies of American petroleum are nearing their end; the struggle must begin again, based on other sources of supply, and against new and powerful opponents.

To the southward of our own border lies the second great petroliferous area, so far as probable time of development is concerned, for it seems likely that the nearby deficiencies in United States' output will be met by greatly increased production from Mexico, Venezuela and Colombia. The fields in this Caribbean area are extensive, though probably not so large as the popular imagination assumes, and they are now in process of intensive development. Within a few years we may fairly expect to see a perfect flood of fuel oils strike the market, whatever may be the condition of the market at the time. Just now there is a large demand for fuel oil, and it is assumed that this demand will increase very rapidly. That assumption is based on the theory that the world is now entering on a period of great commercial and shipping expansion — a theory which is pleasant but not necessarily sound. If so, it will be a remarkable recovery from the losses of the World War.

In discussing Gulf and Caribbean prospects, it is well to bear in mind that the great reserve tonnage in that field, as in California and much of Texas, is essentially a tonnage of heavy oils, which will supply relatively small proportions of gasoline and other light products. For sources of these we must still seek elsewhere.

For the future oil supply of the world, after a relatively short predominance of the Caribbean region, we shall probably have to look to Asia, and particularly to the areas in eastern Turkey and in Persia. These we now find, naturally enough, under the watchful guardianship of our British allies. For the Mesopotamian campaign was not only a subject full of newspaper interest, but it was the one sound commercial enterprise of the World War. As matters stand now, the bulk of the world's probable petroleum reserve is supposed to lie in the southwestern Asia-southeastern Europe region, and it is likely that each year in the future will see vast increase in the output from these areas. The oils vary in grade, but the Persian and some others are on the average a good deal lighter than our own Gulf coast and Mexican petroleums, a fact which makes future competition still more difficult.

With the foregoing facts in mind, we can get some idea of the future of the oil industry in general, and of the American industry in particular. There will be large quantities of petroleum available for market during some decades to come, but the flood will probably reach an early maximum, possibly within twenty years. The United States will lose its rank as the leading producer in a far shorter time, probably well before 1930. The refining and marketing industries, which have been built up with so much care, will have to depend more and more upon the use of imported raw material. Competition with foreign oil producers and refiners will yearly become more difficult, and will probably result in increased attempts to secure American oil holdings in foreign countries. This possibility has already been taken into account, not only by Americans but by others, and not only by individuals but by governments.

When the whole matter is summed up, though the results can not be stated in exact figures, we arrive at a very definite idea as to the limits within which the truth lies,

For all practical purposes the results will be the same, so we may assume that of the known and probable petroleum reserve of the world, at least two-thirds and perhaps over four-fifths is now in the hands of the British government directly, or of British corporations.

Summary. As regards petroleum, the chief problems therefore are not the extent to which petroleum will aid in reducing our coal consumption, but the rapidity with which we can develop some substitute for petroleum itself. There are two lines of attack here, one leading in the direction of distilling oils from shales and the other in the direction of adopting wood alcohol as a motor fuel. Both will probably aid as the supply of petroleum, and particularly of light oils, becomes scarcer. But this point of scarcity will not be reached, for the world in general, for several decades. On the other hand, so far as the United States is concerned,— and even during this present era of world peace we can not entirely overlook the fact that we are Americans,— the outlook is less bright. Barring some unforeseen development we may be in the embarrassing position, during our next war, of asking British permission before our battleships can go to sea. The problem we have to face is not entirely industrial, after all.

Natural Gas

Of minor importance as a fuel, except locally near the gas-fields, natural gas requires little consideration in the present connection. It occurs in many areas all over the world, usually in close associations with petroleum, and it is a normal by-product of oil-field development. The gas produced is used extensively in some localities, as for example in eastern Kansas and western Pennsylvania; it is wasted scandalously in other localities, chiefly because there are no local commercial developments which can use it. The relation of supply to demand is always a purely local

question and must be considered, in each case, with specific reference to some given gas field and some given group of local industries.

Water Power

The development of electricity by means of water power has certain advantages which are obvious, even to the dullest of observers. They are so obvious, in fact, that they should be subject to suspicion on that very account, for there are few simple and plain propositions which are true.

The advantage which appears immediately is that our water power is inexhaustible; that the streams will always be there, so that the power will not become scarcer in the future, like coal. The second obvious advantage is as regards operating costs, for clearly these are very low per unit of power, once the plant is installed.

Starting with these two points of advantage, which do exist, we are apt to move forward onto less safe ground. The intermediate conclusions usually reached are, that hydro-electric power is always cheap per unit, as compared with power derived from coal, and that these unit costs are likely to decrease rather than increase as the plant grows older and larger. Finally, making a still more unsafe step, the final conclusion commonly takes the form of saying that dwindling coal supplies will be made up by water power. If this were indeed the case, no industrial nation need have any fears as to its future. Unfortunately, however, neither the intermediate or the final conclusions are true.

At present, and for many years previous, it has been difficult to find streams on which hydro-electric power can be developed and transmitted cheaply enough to compete with electric plants using coal as a source of power. It takes a very large water power, or one very well located with regard to present or possible industrial development, to make the matter definitely one-sided. In most cases the decision will be very close, and usually in favor of coal. There are

of course areas and countries otherwise situated than we are in this regard. Brazil, for example, may fairly look forward to manufacturing development based on hydro electric power, because in Brazil the water powers are largely located within reasonable distance of the settled portions of the country, and because imported coal is usually very dear.

There is a further error in assuming that electricity is an exact replacement for coal, but in this case the matter has two sides. In considering the future of the chemical industries, which seem likely to furnish a more important part of our industrial development than they have as yet, it is found that the more important chemical industries are relatively large users of both heat and power. This implies that the possibility of securing cheap electricity, or cheap coal, or both, will have an important effect on the future location and growth of the heavy chemical industries. But in this regard there are points of difference to be kept in mind. In many industries, where power requirements are the main things, the source of the power is of less importance than its steadiness and cheapness, and the choice between coal and electricity will in such cases depend on these commercial factors. But in other industries this is not the case, for in addition to the power requirements there are other things to be considered. In many manufactures, for example, heat must be supplied in the course of the chemical process, and in some of these cases there are technical reasons for choosing between the two. The coal, for example, may be needed for its reducing power, as well as for its heat — and the blast furnace furnishes a good example of this. On the other hand, the process may need electricity for electrolytic dissociations as well as for its heating and power value. The different chemical industries differ widely in these particular respects, and their requirements are so divergent that mere mention of these possibilities is all that is possible at present. Enough has been said, however, to suggest that the choice between hydro-elec-

tric and coal power is not always based merely on relative cost or mechanical efficiency.

Electric power does not therefore serve as an exact replacement for coal, and though it is likely to develop greatly in the future, its applications will probably take place chiefly in fields and in regions which are not seriously entered by coal to-day. Future hydro-electric developments, therefore, will have little if any effect in prolonging the life of our coal supply, or in keeping down the future prices of that product.

CHAPTER XI

IRON ORE SUPPLIES OF THE WORLD

Next in importance to the coal necessary to heat our furnaces and drive our engines in this modern industrial age comes the metal produced in these furnaces and used in building both the engines and the tools which some of them will operate. After considering the question of fuel supplies we turn naturally to the nearly related problem of iron ore reserves.

Considered merely as a chemical element, iron is very widely diffused among the rocks and soils all over the earth, making up somewhat over four per cent. of the earth's mass. But if we had to depend on such sources of iron as ordinary rocks, metallic iron would be a very rare and dear product indeed, and not the very common and cheap metal with which we are acquainted. For making iron in a commercial way we must depend on finding comparatively rich iron ores, in deposits large enough to be worth working, and located in such places as to permit transportation to some iron smelting region. In the very early days of the iron industry, a century or more ago, the chief insistence was on the richness of the ores, for the quantity that could be used in the small charcoal furnace or forge of these days was very small — a matter of a few tons of ore a day, or even less for the forges. And since in those days there was usually no grouping of units, the single furnace was all that need be considered. The processes available, too, were crude; and even when a very rich ore was used the losses in slag were very large. To-day, with furnace groups needing hundreds of thousands of tons of ore per year, the insistence is on quantity, and a deposit containing a few thousand tons, even of very rich ore, is of no commercial value whatever.

Tonnage and transportation are therefore prime requisites; quality is still important, for it affects the cost of the product, but, within limits, it is less important than are the other two factors.

At our present stage of industrial development, iron ores have acquired great technical and commercial, importance, and they are in addition becoming objects of political interest, both nationally and internationally. A large number of factors determine the importance and the utilization of different iron ore deposits, and the questions which arise can not be discussed here in any detail. We can only state briefly, without explanation, some of the facts that have to be considered in the present connection, and to refer to the volume below noted [1] for further details. Unless otherwise noted the tonnage estimates and other data here used are taken from that volume.

Total iron-ore-reserves. As in the case of coal, there have been at intervals serious inquiries as to the possibility that the iron ore supplies of different industrial nations were nearing exhaustion, and these have led at different times to the preparation of estimates of reserve ore tonnages. There has been also, in the United States at least, another factor at work, which has led to even more serious and careful studies along the same line. This newer and more pressing factor has been the charge that iron ore supplies are being monopolized by one or more great corporations. The charge, of course, could be made without any preliminary investigation, but its refutation required facts.

Altogether, in one way or another, there are now sufficient data available for forming a pretty definite idea as to the iron ore tonnage known to exist in at least three of the continents. Furthermore, we are able to make some fairly precise estimate as to the probable tonnage of the remaining three. There are of course wide chances, both for error

[1] Eckel, E. C. "Iron Ores; Their Occurrence, Valuation and Control." New York, 1914.

and for difference of opinion, in regard to such estimates, but it must be recalled that we are not dealing with a very small-scale product, and that the error would have to be very large indeed before it would vitiate any of the conclusions we might draw from the data.

In any case, the final estimate for the known iron ore tonnages of the three best-known continents gives results as follows:

	Iron ore tonnage	*Equivalent in metallic iron*
North America	15,000,000,000	6,455,000,000
South America	8,000,000,000	5,000,000,000
Europe	12,000,000,000	4,735,000,000
Total tonnage...	35,000,000,000	16,190,000,000

This gives us a very large total, some 35 billion tons, as compared with an annual iron-ore requirement, in all the world, amounting to about 160 million tons. If the world's requirements did not rise, in future, above those of 1913, which was the last year of heavy demand, the three continents above noted would be able to fill the demand for the next two hundred years.

But in addition to the known ores of Europe and the two Americas, it must be recalled that we have three more continents to draw on for the future. If we assume that they will yield iron ore about in proportion to their land areas, we arrive at a probable ore tonnage for Asia, Africa and Australia combined of some 57 billion tons.

Taking both sets of figures into consideration, it seems probable that we can count safely on a total world tonnage of iron ore amounting to some 92 billion tons, or over five hundred years supply at the present rate of utilization. It has previously been said that slight errors would make no serious change in the conclusions drawn, and the justice of this statement can now be appreciated, in view of the tonnage figures at which we arrive.

If we could drop the question at this stage the results would be satisfactory enough, for surely a five hundred year supply of good ore would remove the more pressing fears as to the future. Unfortunately, however, there are two factors yet to be considered, both of which operate to curb our optimism. The one most commonly brought to notice is the possibility of steady future increase in the annual requirements for iron ore. The other is the certainty that our iron ores, and consequently our finished iron and steel, will cost more in future than they have in the past. Both of these difficulties are very real, and demand consideration here.

As for the first, we have the fact that for over a hundred years the iron ore output of the world has, on the average, increased about four per cent. over the output of the year preceding. This is of course due to increased demand for pig iron, and if kept up at this rate it would imply that in a hundred years from now the annual ore requirement would be well over one thousand million tons, so that there are really about two hundred years of good ore supply. That would place the iron ore reserve on about the same basis as the coal reserve — a matter which two centuries would place in a very serious position *provided* the recent rate of industrial progress continues. This last question is one that will be discussed later.

The second point of serious interest regarding future ore supplies is one that affects cost of iron, rather than quantity of ore. It arises from the fact that in the total reserve estimates there are many thousand million tons which are so located geographically that they can not enter the market to-day, and that they will not be able to enter it until pig-iron prices are much higher than this generation has been accustomed to paying. The result is that the whole ore supply of the near future will be drawn, in annually increasing tonnage, from a relatively small group of ore deposits.

Some of these are already showing signs, not of exhaustion, but of increasing scarcity. This is clearly indicated by the fact that the average grade of ore shipped to our furnaces falls off a little each year, or at least each few years. The rate at which the average ore grade lowers, can be determined with some approach to exactness. It amounts, for the northern United States, to a fall of about half of one per cent. a year in the metallic iron content of the average ore used. This does not seem large, stated in percentages, but it means an increase, other things being equal, of pig iron and steel costs year after year.

There is a further matter to be considered, and this is industrially the most serious. It relates not to the exhaustion of the world's ore supply *en masse,* but to the relatively rapid exhaustion of certain portions of that supply, so that certain given iron and steel districts will in the near future operate at a disadvantage as compared with other districts of which they have hitherto been competitors. This can best be understood, if before discussing its results, we examine the manner in which the world's total iron ore reserve is localized geographically.

The great ore regions. In a previous tabulation it was shown that the iron-ore reserves of Europe and the two Americas aggregated some 35 billion tons. This tonnage is, however, not equally scattered over the surface of these three continents, but is on the contrary relatively concentrated. By far the bulk of the total known reserve is found in one of a very small number of great ore districts. For our present purposes it may be assumed, with a reasonable approach to exactness, that over four-fifths of the known reserve tonnage is contained in one of ten ore fields or regions. In the tabulation on the following page the reserve tonnage is given for each district, as well as the current rate at which this reserve has been drawn on during recent years of normal trade. The last column, arrived at

by simple division, gives the number of years for which this draft could continue before exhausting the supply of any given ore district.

Region	*Ore reserve, millions of tons*	*Annual shipments, millions of tons*	*Duration, years*
Brazil	7500	none	..
Lorraine	5600	40	140
Newfoundland	4000	1	4000
Cuba	3000	2	1500
Lake Superior, U. S.	2500	55	45
Southern U. S.	2000	6	333
Scandinavia	1500	8	188
Great Britain	1300	16	81
Spain	700	10	70
Northeastern U. S.	600	2	300

It will be seen immediately that this comparison puts the ore situation in a new light. If our present rate of shipments continue, some of the best known of the world's iron ore regions have not a century to live. If the shipments increase in the future as they have in the past, it is not a question of centuries but of decades for these districts. The result will be of course, not that the world's steel industry will come to an end soon, but that there will be great changes in the source of its ores. These changes will be accompanied by other commercial developments in new regions, and by increasing cost of ore, which in the long run means higher priced iron and steel.

The iron ore situation; summary. In the present chapter we have gone over the leading facts relative to the iron ore supplies of the world, in so far as these facts have any direct bearing on our general subject — the development and future of industrialism and of world leadership. The chief points of interest developed along these lines may perhaps be fairly sumarized as follows:

1. There is no danger of exhaustion of our iron ore supplies for a very long time to come. At our present rate of

consumption the known reserves would last for many hundreds of years. At our recent rate of increased demand, they will last for several hundred years.

2. As demand continues, even if it should not increase, we will have to rely to an increasing extent on using poorer and more distant ores. This involves increasing cost per unit of metal produced. Other things being equal, the cost of iron and steel will rise steadily each decade.

3. The draft on certain leading regions is even now very great in proportion to their reserve tonnage. This will lead, in the near future, to great shifts in manufacturing locations. Some of these shifts will be within a country, building up new manufacturing regions.

4. Other shifts which may be anticipated will be on a larger scale, affecting the relative ranks of various countries in world trade and leadership. These effects of increasing ore scarcity will have to be considered in connection with facts already presented as to coal supplies.

The foregoing general statements will be recurred to later, in Chapter XXV when we come to discuss the future of world competition and leadership.

CHAPTER XII

THE SUPPLY OF THE PRECIOUS METALS

In discussing gold and silver we have to deal with metals which are not only of great importance as raw materials of manufacture, but which have a very special place in our economic world as being the bases of all modern currency systems. Their importance in this latter sphere, as coinage metals, is indeed so great that we often overlook the fact that a very large proportion of the world's gold and silver output does not enter the currency at all, but is taken up for decorative or other industrial purposes. This fact, as we shall see later, contributes to render very indefinite the relation between gold supply and prices.

The older gold supplies. Prior to the discovery of America, the civilized world was living very largely upon the gold and silver which remained to it from the accumulations of far earlier ages. In ancient times slave and captive labor, worked mercilessly on uneconomic deposits, had produced in the course of centuries quite a respectable stock of the precious metals. Even allowing for the relative poorness of forced labor, you could work a very poor mine indeed if you did not have to give your workman anything except food, if you could work him until he dropped, and if you could steadily replace the exhausted working force by merely going out and catching a few more barbarians. On these accounts the ancients were able to work gold deposits which now are useless to us, in Europe, Asia and Africa. They could not work anything which required machinery or technical appliances; but they could work anything which merely required labor. So, whenever we come across ancient mine workings for the precious metals, we are apt

to find that they are of too low grade for even our present methods.

Another error as to ancient conditions is introduced by the fact that wealth was in those times excessively concentrated, as compared with recent periods. Such things as gold and silver were carefully hoarded, passed from hand to hand by conquest, and finally gravitated into the possession of a very few people in several conquering nations. During later periods they passed into the hands, in large part, of a very durable and practically universal institution, the Church. If we recall that at the time of the Reformation the Church owned absolutely half the landed area of England we shall get some idea of the sort of concentration of ownership that was probably taking place with regard to the gold and silver supply of the Christian world. Now all this concentration did not of course increase the total supply, but it tended to make it very obvious and impressive. Even to-day we tend to get an unfair idea of the number of precious stones in the world when we see a munition manufacturer's wife on exhibition. So in older times a few secular rulers and a few ecclesiastical dignitaries, the profiteers of those times, had known hoards of precious metals which tended to make the world seem richer than it really was. Perhaps we can get a better idea of the facts if we recall that, according to the best available estimates, all of Europe possessed at the time America was discovered less than one hundred million dollars worth of gold in any form. This represented what was left from six thousand years of recorded search for gold. For comparison we may say that this amount is about equal to-day to an ordinary year's output, not of the whole world, but of South Africa or Australia or America, separately.

The American treasures. With the discovery of America, this condition of gold-poverty was sharply changed. Within twenty years the New World had doubled the gold supply available for European use; and in each twenty years

thereafter another hundred million dollars worth of the precious metal was shipped to Spain and Portugal. Much of this gold reached other countries, either directly by piracy or indirectly by trade. Along with the new gold came new silver, not in the present coining ratio but in quantities perhaps fifty times as great as that of gold. The flood of the precious metals was such that, from the overflow into England, Elizabeth was able to reëstablish a sound coinage in place of the scandalously debased issues of her father.

As the new gold actually entered coinage systems, and became an actual factor in trade, prices of all commodities rose in all countries which were affected by the new condition. This is one of the two clear instances where a new gold discovery has had this effect. The other was in the middle of the nineteenth century, as we shall see later. In all other cases the evidence is by no means clear, as we shall also see later. But before going on to this controverted question it will be well to see what actual and immediate effects do come unquestionably from new gold discoveries.

The initial local effects. There is, of course, an immediate and very direct influence exerted by a new discovery of the precious metals, but particularly of gold, on commercial activity and prices. It has been pointed out, most forcibly perhaps by De Launay, though earlier recognized by others, that men will seek for and extract gold with an energy and disregard of expense utterly disproportionate to the value of the actual product. It is indeed considered probable enough that, were it possible to assemble prospecting and mining costs for all the gold that has been extracted throughout the world from 1849 to the present day, we would find that it had averaged in actual cost far above the $20.67 per fine ounce, troy, which is its commercial value. This, taken in connection with the very characteristic rushes to a new gold district, indicate very clearly that discoveries of new sources of gold supply have

a very immediate and direct effect on prices and activity. Though this immediate effect on prices is commonly local and not general, the increase in activity may spread far beyond the region of the new goldfields, and if the discovery be important enough, the effects may be shown over a long period of time and with very striking final results. The rapid development of California, Australia and South Africa after important gold discoveries are cases in point. In all of these the development was incited and for a time guided by gold. Later, in all three cases, the development was finally justified by other conditions, so that in the cases of California and Australia at least the present gold production is a relatively unimportant item in the wealth of the regions. But this does not alter the fact that their development was originally caused and forced by discoveries of gold.

In the case of silver the effects are not so immediate or so striking, owing to the fact that in most cases silver is so closely associated with other metals that its metallurgy is complicated, and the bulk of it really appears as a by-product of lead or copper mining and metallurgy. But even in the case of silver we have examples, as during the original building up of Nevada, of conditions favoring the small miner and therefore causing a rush to the new district. Our classic examples, of course, are of greater age and of somewhat different character, for in the cases of the Spanish conquests of Mexico and Peru the rush to the newly found silver regions, and their later development, were originated and carried on by a great state, acting through organized military and political powers.

Broader effects on the price-level. But entirely aside from the immediate and local effects of the discovery of new sources of gold or silver, there are much more important and enduring effects upon both prices and commercial and industrial activity. These arise from the fact that these particular metals have from time immemorial been,

not merely articles of commerce, but coinage metals. They are the final basis of value, against which we fix the price of all other commercial products.

This being the case, it is clear that we might fairly expect to find that great changes in the current supply of the precious metals would effect changes in the general level of prices and in the general degree of commercial and industrial activity. We may indeed put the matter in more precise form by saying that: *Other things being equal, an increase in the production of the precious metals will tend to cause a rise in the general level of prices, and an increase of commercial activity, while a decrease in gold and silver production will tend to cause a general fall in prices and a decrease in trade activity.*

The two qualifications introduced into the preceding statement —" other things being equal " and " tend," are however very important, and must be considered in some detail before we can go on to further discussion of the precious metal supply itself. The other things which prevent the tendency from being a constant, direct and immediate effect are suggested if we state the case in the following inverse order, limiting attention to gold in order to avoid consideration of bimetallism.

Any increase in the annual output of gold would cause an immediate and practically corresponding rise in general prices *provided* that

1. Gold were the sole monetary basis and that no credit instruments (bills, notes, checks, acceptances, etc.) were in commercial use.

2. All the annual gold output were employed in coinage, and there was no demand for gold as a commodity (i.e. for jewelry, industrial uses, etc.).

3. There were no preëxisting stock of gold, so that the output of any given year or other short period would be decisive.

It does not take long consideration to see that, as a

matter of fact, not one of these three necessary conditions holds true at any time in civilized countries of modern type. Credit instruments are becoming increasingly important, as compared with gold coin, and even though credit may in the last analysis be based upon a gold reserve, the connection is not direct and unqualified. Furthermore, there is a very large proportion of the gold mined each year, probably well over half of it, which does not reach any mint, but goes directly into commercial utilizations. Finally, the existing stock of gold is very large, so that the additions of any one year or series of years do not represent a great change in percentage.

With all three conditions unfulfilled, purely theoretical arguments as to the necessary and direct effects of gold output on prices lose much of their force. It will be more satisfactory, however, if we abandon theory entirely and make a direct comparison between gold output and prices for a long series of years, for which we have fortunately ample data.

The test of experience. In the diagram presented herewith (Fig. 6), an attempt is made to submit the theoretical question to the test of experience. In this diagram the solid line represents the annual gold production of the world, expressed in hundred millions of dollars, as given in the reports of the Director of the United States Mint, for the period 1800 to 1910 inclusive. The broken line represents the course of average prices during the same period, the figures used being the combined Jevons-Sauerbeck index numbers, as stated by Layton.[1] The following points seem to be suggested by this diagram.

1. During the period covered, of over a century, the general course of prices has been downward, with a maximum in 1809 and a minimum in 1897. At the close of the period prices were less than half as high as at its com-

[1] Layton, W. T. "An Introduction to the Study of Prices." London, 1912, p. 116.

mencement. During the same period the annual gold output has increased almost steadily, with a minimum about 1815 and a temporary maximum in 1910. At the close of the period the annual gold output was over forty times as much as at its commencement. In place of there being a general correspondence, during this century of modern in-

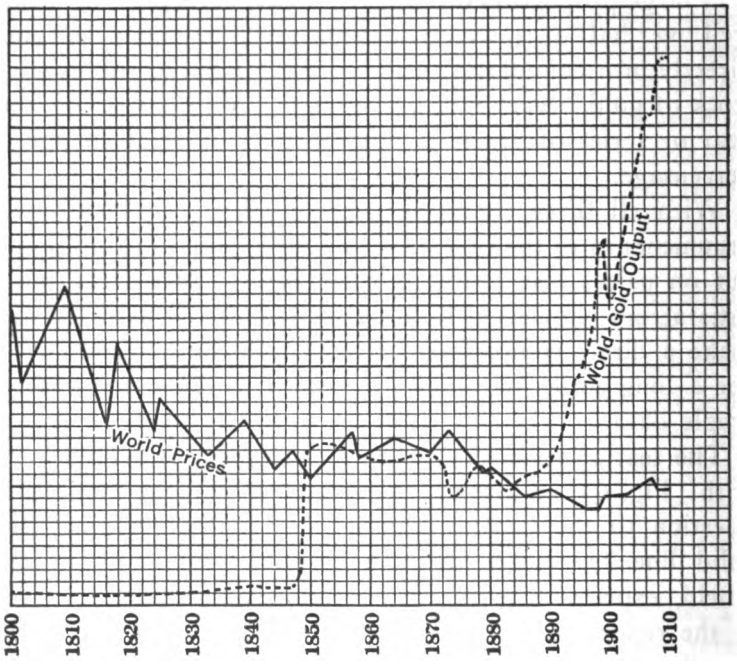

FIG. 6. Prices and gold output, 1800–1910

dustrialism, between the course of prices and the output of gold, there was in fact a very violent disparity. Perhaps it would be fairest to say that *even* a flood of gold was unable to prevent a general fall in prices.

2. If, instead of treating the century as a whole, we consider it in three periods, the results are worthy of consideration. The first period is from 1800 to 1848, during which prices generally fell; while the gold output after about 1815 rose steadily under the influence of the new

output from Russia and Siberia. This rise in gold output, though we now look upon it as trifling by contrast with later discoveries, more than tripled the annual rate of gold production. For this period of half a century, therefore, the evidence seems to be directly against any important influence of gold output on prices.

3. During the second period, from 1848 to about 1884, there is a rough general correspondence between gold and prices. The gold output rose sharply, on the Californian and Australian discoveries, so that around 1860 it was perhaps five or six times as great as in 1845. Prices rose, from 1849 to 1857, almost forty per cent. Again, prices reached a high point in 1873, and declined from then steadily to 1897, while gold output declined also from a high in 1878 to a low in 1873. Prices therefore started to fall five years before the gold output fell off — a singular case of prescience — and continued their fall for fourteen years after the gold output had commenced a still more violent rise.

4. Finally, in the last pre-war period, prices rose about thirty per cent. from 1897 to 1910; while gold output increased over fourfold in its rise from 1887 to 1910. The further violent rise in prices during the Great War has, it will generally be admitted, no relation whatever to gold output.

Summary of results. Having considered the effects of precious metal output on prices, both from a purely theoretical standpoint and in the light of the world's actual experience, it will be of advantage to summarize the results of these two lines of study. The following conclusions, limited enough it will be seen, seem to be justified.

The discovery of large new precious metal deposits, and particularly of placer deposits of gold, acts powerfully to force rapid development of new territory. Both directly and indirectly it contributes toward a rise in prices and industrial activity. At first these effects are local, shown in

the regions near the discovery, but if the output is important enough, they finally exert a wider influence. Under particularly favorable conditions they may finally influence world activity and prices for a time. The influence thus exerted is in part purely psychologic, owing to the drawing power of gold; it is in part due to the free expenditure of the newly rich; its extent and duration depend largely upon the real value, other than for gold, of the territories developed.

The increase in gold output, once the period of discovery is over, has little or no effect on prices, save in so far as new gold enters the monetary systems of the world. Even this effect tends to decrease as we become more used to credit instruments in place of gold, and as the existing coined stock of gold increases. The extent to which the annual output is drawn into mints is not determined ordinarily by the amount of the output, but by other considerations.

Finally, a general rise in prices, by whatever process caused, acts in the long run as a powerful brake upon increases in gold output. Gold sells at the same price per ounce, regardless of the cost of powder, timber, mill supplies and labor; and as these costs rise during periods of high prices, mine after mine is compelled to shut down. This effect has been clearly demonstrated during the years 1915 to 1919 inclusive. Only revolutionary changes in gold metallurgy could change this condition, so that we may assume that whatever may be the effects of gold output on prices, they are rapidly self-compensatory. As prices rise higher and higher, more and more gold mines will have to shut down; as labor and commodity prices fall, more and more gold mines will be opened or re-opened.

The future of gold supply. Looking back over the history of gold production, we can see that it has been even more irregular than that of the purely commercial metals, though the irregularities have been disposed in longer swings

or cycles. At the beginning of each cycle we have had the discovery of some new large gold-producing area, and for a number of years following there has been always a heavy increase in annual output, while the new placers or surface deposits were being cheaply worked. At a later stage, when the cheaply worked portion of the new supply has been secured — and this is ordinarily a matter of only a very few years — there is a tendency to falling off in output. A little later still, this is again counterbalanced by new deeper mining or the larger-scale working of lower grade deposits.

During the past century and a half there have been a number of great gold discoveries, each in turn following out the line of development and decline above noted. The net result, however, has been a fairly great increase in annual output, for so far none of our larger fields has been completely exhausted before another new discovery was made. But there have been great gaps, of several decades each, between really great discoveries. One of these gaps seems to be in prospect now, for all of our present sources of supply appear to have reached and passed their maximum of output, and for many years past there has been no new large discovery to take their place.

South Africa, for example, which has long been the mainstay of the gold supply as a single producer, seems to have definitely passed its maximum of annual output, and to be preparing for a slow decline in productivity. Estimates indicate that the Rand output of 1930 may fall to half that of 1915; and that by 1945 the annual output will be only a quarter of that of the earlier date. Actually the rate of decline may not be so rapid, owing to the development of new mines, in ground now deemed doubtful. But the period of actual growth in output is certainly ended. The same thing may be said of most of the other goldfields now worked in other parts of the world.

When it becomes obvious that the gold output is actually declining, we are likely to see efforts made in the way

of careful search for new fields and in the working of lower grade ores. For some time past this last solution of the difficulty has been impossible, because labor and commodity prices were too high to justify working a very low grade ore, even under very favorable conditions as to size and location of the ore body. But as commodity prices fall and labor becomes more abundant low grade mines will again show a profit.

The case of silver. Silver might perhaps be put in the same class with lead, so far as relation between possible supply and industrial demand are concerned, for there has never been any reason to doubt the abundance of known silver deposits. But silver has a place in coinage, as well as commercial uses, and as the warring nations come to readjust their shattered finances there may be a relatively large demand for silver in the decade to come. There is such a demand at present, it is true, but that is a matter of Chinese and Indian requirements, and is due chiefly to exchange conditions. When that particular demand has subsided we may look forward to increased demand from Europe, as the first step back toward a metallic basis for currencies.

Unless such a currency demand should materialize, however, we will see silver selling at far lower prices, for the known ore supply seems to be excessive as compared with the demand for silver as a purely industrial metal.

CHAPTER XIII

THE SUPPLY OF COMMERCIAL METALS

In the chapters immediately preceding there has been an attempt to summarize the leading facts relative to the supply and distribution of the chief mineral raw materials — the fuels and iron ore. With these alone as a basis we could go far toward establishing and carrying on a great industrial development, but as progress continues there arises demand for certain special products which require other raw materials. These other minor materials are not seriously important, as compared to coal or iron, and in case of their disappearance the world could undoubtedly make shift to replace them by substitutes, or even to get along without them entirely. But they do have a place in industry, and the extent and localization of their supply are matters of interest in connection with the future of industrial development and of world competition.

Coal, petroleum and iron ore and the question of gold and silver supplies have been previously discussed. After making these important exceptions, the remaining mineral products of broad industrial interest may be roughly classified as falling in one of three groups; metals, chemical raw materials and structural materials. These will be taken up in the order named.

The difficulty in discussing the present and future metal supply available for the world's industrial development arises chiefly from the fact that, with the fortunate exception of iron, most metallic ores occur in deposits of such character that their extent can not be determined very definitely in advance of pretty thorough exploitation. There

is the counter-balancing advantage, however, that the supply of the minor commercial metals comes largely from widely scattered deposits, so that even a serious error with regard to the probable supply at one point will have little effect on the final conclusions.

It need hardly be said that consideration will have to be limited here to the leading commercial metals, concerning which most information is fortunately available. The so-called rare metals are not only comparatively unimportant from either the commercial or the industrial standpoint, but in many instances their rarity is more apparent than real, and would disappear very promptly if any serious and continued demand arose for large tonnages.

With these limitations, the commercial metals which remain to be considered here are: copper, aluminum, tin, nickel, lead, zinc and mercury. These will be briefly discussed in turn, but before doing this it may be well to get some idea as to the relative commercial and industrial importance of these different metals. Some of the facts developed may be rather surprising, and some of their implications may be still more important.

Relative tonnage importance. It will be convenient to take, as a starting point for our study, the actual tonnages of the various metals produced all over the world in the year 1913. It may be noted here that, throughout this volume, most comparative statistics have been presented for that particular year, even though later data are available, because it was the last year of unrestricted trade and normal development throughout the world. It was, moreover, a fairly prosperous business year, but not by any means a "boom" period. From 1914 on manufactures and industry were hampered in most countries, or diverted into exceptional channels, so that no later year gives a fair basis for comparison. With this explanation we will return to consideration of the special question — the relative quantitative importance of the commercial metals.

WORLD'S METAL OUTPUT, 1913; TONNAGE AND VALUE

Metal	*Output, metric tons*	*Total value, dollars*	*Average value, dollars per lb.*
Iron	78,000,000	$1,170,000,000	$0.00¾
Lead	1,155,000	114,500,000	.04½
Copper	997,600	330,000,000	.15
Zinc	994,000	120,300,000	.05½
Tin	118,000	103,800,000	.44
Aluminum	80,000	35,200,000	.20
Nickel	33,000	39,000,000	.40
Silver	7,200	180,000,000	8.50
Quicksilver	4,245	4,675,000	0.50
Gold	682	455,000,000	300.00

The disproportion between iron and all the other metals, so far as quantities are concerned, is enormous. For a good many years, in fact, pig iron has accounted for over 95 per cent. of the total metal output of the world, by tonnage. Even in value, it amounts to over half of the total.

Relative rate of growth. There is another feature which may be deduced from the statistics which are available, and this is the relative rates at which the world's output of the different metals has increased during recent years. It is to a large extent an index of the rate at which demand has increased; but this is not true in every case, because we do have a few metals whose output can no longer increase rapidly. As a basis for this comparison we may take the respective outputs of the different metals in 1903 and 1913, and calculate the rate of increase during the intervening decade. This is done in the following table.

Metal	*Output, 1903, metric tons*	*Output, 1913, metric tons*	*Rate of increase, per cent.*
Iron	46,400,000	78,000,000	68
Lead	902,600	1,155,000	28
Copper	591,300	997,600	68
Zinc	571,600	994,000	73
Tin	100,500	118,000	17

Metal	*Output, 1903, metric tons*	*Output, 1913, metric tons*	*Rate of increase, per cent.*
Aluminum	8,200	80,000	875
Nickel	9,900	33,000	233
Silver	5,250	7,200	37
Quicksilver	3,600	4,245	18
Gold	490	682	39

On looking over these results we will see immediately that there were vast differences in the rate of development of the metal industries. Of the leading commercial metals three — iron, copper and zinc — showed almost the same rate of increased output in the course of the decade, averaging close to 70 per cent. Two — aluminum and nickel — showed phenomenal rates of growth. Two others — tin and quicksilver — showed very small rates of increase, so small as to arouse suspicions as to their future, which we shall see are justified. The others — gold, silver and lead, showed rates of increase intermediate between the growing industrial metals and the vanishing metals.

Relative natural abundance. The matters so far discussed deal with questions of present fact, which can be readily checked against error. It is possible, however, to carry the investigation further, along a very interesting line, but one which it is necessary to follow with extreme care. This leads us to consideration of the relative natural abundance of the various metals in the earth, and to the relations which exist between this abundance and their present output and price. It can be seen that, if we had complete data on the main point, we could draw some fairly precise conclusions as to the future of the different metals. But the data are not complete, and it is hardly necessary to warn the reader that the results we obtain by their use are merely tentative.

The following table contains the data we have available as to the relative natural abundance or scarcity of a number of our most important commercial metals. The percen-

tages quoted in the first column of figures are, so far as iron, aluminum and nickel are concerned, taken from the most recent work of Dr. F. W. Clarke.[1] Those relative to the other metals are from a recent estimate by Prof. W. Lindgren,[2] and are to be regarded as the most authoritative statement on the subject. The last column is simply figured from the percentages, so as to bring out comparative results more sharply.

RELATIVE NATURAL ABUNDANCE IN EARTH'S CRUST

Metal	*Percentage in earth's crust*	*Relative abundance gold = 1*
Aluminum	7.84	15,680,000
Iron	4.44	8,800,000
Nickel	0.023	46,000
Copper	0.0075	15,000
Zinc	0.0040	8,000
Lead	0.0020	4,000
Silver	0.00001	20
Gold	0.0000005	1

These figures may now be used, subject to the caution already noted, as the basis for a further comparison. This has been done in the following table, in which the data for annual output and cheapness are derived from the figures previously given for the results of 1913.

Metal	*Natural abundance*	*Annual output*	*Cheapness*
Gold	1	1	1
Silver	20	12	34
Lead	4,000	1,700	6,700
Zinc	8,000	1,460	5,400
Copper	15,000	1,470	2,000
Nickel	46,000	49	750
Iron	8,800,000	115,000	40,000
Aluminum	15,680,000	117	1,500

[1] Data of Geochemistry, Bulletin 491, U. S. Geological Survey, p. 32–34.
[2] Mineral Deposits, p. 14.

There are two conclusions, and two only, that it seems safe to draw from the remarkable disparities shown by the preceding table. The first is that two metals — nickel and aluminum — may fairly be expected to play a more prominent part in industry in the future than at present, for unless the data as to natural abundance are very faulty they are entirely too common in nature to be made at the rate of only 33 and 80 thousand tons a year respectively. The second conclusion which seems justified is one which De Launay first noted — that gold seems to be ever-produced by comparison with its real natural scarcity. But any further use of this comparative table, interesting though it may be, leads us into a field too speculative to be of much service in our present study, and the matter may accordingly be dropped at this point.

From these strayings in the direction of a somewhat nebulous metallurgy of the distant future, we may profitably turn to consideration of a coldly practical problem — the supplies of commercial metals — and commence with the metal which is, next to iron, of broadest general importance to our present civilization.

Copper. Copper, now second of our commercial metals in importance, was in reality the first metal known to human industry, and for very many centuries it was a far more important product than iron. The ancient civilizations were built up, not on iron and steel, but on copper, tin and gold; and each of these metals has over six thousand years of recorded history behind it.

The copper production of the world has increased from a total of perhaps 15 thousand tons in 1820 to about 55 thousand in 1850; and so on up to its present output of close to one million tons annually. Its growth has been in close sympathy with progress in armaments and in electrical development, and these two factors account for most of the fluctuation in copper demand throughout the past century. Of the two, electrical development at least seems likely to

grow at an increased, rather than a decreased, rate during some decades to come, while there is as yet no serious falling off in the probable demand for armaments. The future demand for copper, therefor, seems likely to increase at a rate greater, perhaps, than it has shown in the past.

The geographic distribution of the copper industry has changed very strikingly during the past few decades, for along with increased total output has come a very great shifting in the relative rank of the different producing countries. In 1880, for example, the world copper output was about 150 thousand tons and of this over two-thirds came from Chile, Spain and the United States, in the order named. At that date the United States was making just about one sixth of the total. But from then onward steady growth in the American output gave over half the world output by 1895, while Japan had reached a figure almost equal to that of Chile, and Mexico was beginning to show development. Another decade, and the two old leaders had fallen back to fourth and fifth place respectively, for while the United States maintained its position both Japan and Mexico passed Chile and Spain. Still later Australia produced larger amounts, and entered fourth place.

In the years immediately preceding the World War we may say that the total world output of copper was somewhat over 800 thousand tons annually, and that of this total the United States produced over half. The remaining production was widely scattered, with Japan, Mexico and Australia making some 50 thousand tons each, followed by Spain, Chile, Peru, Russia, Canada and Germany, all of which had annual outputs of from 20 to 40 thousand tons.

As to future changes in geographic distribution of the industry, there are some which seem probable enough. The United States will maintain its leadership for a very long time to come, but it is likely that the percentage of total output produced in the States will fall off, and that perhaps very soon and quite markedly. The new increases in pro-

duction are most likely to come from mines in Mexico, Peru, and Chile, and the Belgian and French Congo regions.

As regards future copper costs, the industry is in an interesting and curious position. The prices received during the World War were very high, and it is probable that the copper prices of future years will fall off steadily, along with those of other commodities, as currency inflation is progressively reduced. But there is no reason why copper prices should fall off faster than the average of commodity prices, and some reason to believe that they will not fall off as fast. During the past decade we saw a very great revolution in mining and treatment methods, resulting in the copper market being overloaded, at times, by the enormous output of the new low-grade western mines. It is unlikely that a similar situation will occur again, for some time to come at least. Meantime these mines seem to have reached their maximum of output, and to have passed their minimum of cost. There are no new developments immediately in sight which will operate to press down prices with the same force in future. Indeed, it is probable enough that the first great renewal of industrial activity after the war, a renewal which does not seem imminent but which will certainly come sooner or later, will find a relatively short supply of copper. As with coal and iron, we may easily have passed extremely low prices for all time to come.

Actual conditions as to known copper ore reserves and economic rate of output appear to indicate that whenever the economic structure of the world gets into shape again, after a severe and perhaps long readjustment, we may face for a time something like an actual scarcity of copper. It is true that, at this date, the copper mining and copper refining capacity of the world is far larger than it has ever been before. It is also true that, thanks to the development of the large low-grade ore supplies of Utah, New Mexico and other western states, we can now safely figure on a known and determined ore reserve far larger than

ever before. But when this is said we must admit on the other side that the Lake Superior, Rio Tinto and other older districts are nearing their end as important producers, that the known low-grade deposits are now developed to somewhere near their maximum economic rate of output, and that some even of these newer producers are well advanced toward exhaustion. The result is that, despite the large known ore reserves, there is not now in sight anywhere such a new tonnage as has been overhanging the market while these western deposits were in course of development.

Whenever the world experiences another period of extensive industrial activity, therefore, it is probable that copper will be somewhat scarce and relatively somewhat dearer than it was during the years just before the war. The trend may on that account be toward somewhat higher copper prices, regard being paid of course to the course of average commodity prices. The end will come, either through new developments in Africa or elsewhere, or by the competition of aluminum, a factor which is daily becoming more important, since this new metal can replace copper very effectively for some of its most important uses.

Aluminum. The metal now to be considered is relatively new, its use dating back less than a century, as compared with the six thousand years during which mankind has used copper. Nevertheless, its growth during this short period has been one of the most astounding in all industrial development. First made commercially by St. Claire Deville in 1855, it remained little more than a chemical curiosity for thirty years, during which the output was relatively small at a price decreasing from ninety down to five dollars a pound.

During the decade 1880-1890 the industry changed sharply, under the stimulus of several great inventions relating to aluminum metallurgy, for the Gratzel, Cowles,

Heroult and Hall patents all date back to that decade. From about that time on we can look upon aluminum as a real commercial metal. From an output of a few hundred pounds, at a price of five to ten dollars a pound in 1880, we have come to a current world output of some fifty to sixty thousand tons a year, and the price now falls, during years of depression, to well under twenty cents a pound. The cost of manufacture in Europe, during the years immediately preceding the World War, seems to have been not far from ten cents a pound, and in future this figure may be reduced rather than increased, since there is no lack of raw materials for this industry at least.

Geographically, the industry is localized very sharply. Of the current total of some 50 to 60 thousand tons annually, about half comes from the United States and Canada; a quarter from France; one sixth from Switzerland and the Central Powers, and one eighth from England. Italy and Norway enter the market with smaller tonnages. The localization, within the countries, is still more pronounced, the output being all made in a few very large units. The points of manufacture, within the country, are determined very largely by the existence of cheap electricity, for the main processes of reducing aluminum from its ores are now electrolytic.

The chief ore of aluminum is the mineral known as bauxite, a hydrous aluminum oxide, which occurs in large deposits in many parts of the world. The principal deposits now worked are in Arkansas, Georgia, France and Italy; but very heavy tonnages are known to exist also in India, French and British Guiana, and Cuba. In this dependence upon one particular mineral as its main ore aluminum differs sharply from iron, and this accounts in part for the difference in output and cost of the two metals. As to natural abundance, we have seen on a previous page that the earth's crust contains almost twice as much aluminum as iron; but this high aluminum content exists almost entirely in the

form of aluminum silicate minerals, while aluminum oxides are rare as compared with iron oxides.

It may be borne in mind, however, that this rarity is only relative, and that bauxite of one grade or another is far from being a scarce mineral. But in its better grades, free from iron and silica, it is relatively scarce, and one limitation on the ultimate cheapness of metallic aluminum is thus brought into view.

With this fact in mind, much attention has been directed toward the development of processes by which metallic aluminum could be produced from the very common aluminum minerals, such as clays and feldspars. Clay has of course been a particular favorite in this line of study, and numberless processes have been invented and patented covering some method of producing aluminum from clay. The chemical difficulties are of course not insurmountable, but with regard to the commercial side of the matter the case is very different. So far as we can see now, it will always be cheaper to use bauxite as a basis for aluminum metallurgy than to use clay or any other aluminum silicate. It would take great changes in the cost of electricity or of chemical reagents to destroy this initial advantage of bauxite, even if we assume that bauxite deposits are very scarce. And this latter conclusion does not seem to be justified by our present knowledge.

The future growth of the aluminum industry seems likely to depend, in great part, on the manner in which it replaces other metals. Aluminum does have some special properties which give it special uses, but to a great extent it is coming into service as a replacement of copper (in wire) and of tin and enameled ware elsewhere. As against copper, the competition is a matter of weight and electrical resistance, which are fixed quantities, and of relative price, which is not fixed by nature. The aluminum output of the future is likely to be produced at lowered costs, while that of copper seems more likely to be made at slightly increased

costs. As against tin, the other metal which meets aluminum in competitive uses, the case is very definitely in favor of aluminum. We will see later that tin seems on the way to becoming a very scarce metal indeed. The prospects are in favor, therefore, of heavily increased aluminum output in future.

Lead. Unlike the metal last discussed, lead has a very long industrial history, for even in Roman times it was utilized for many of its present purposes.

At the end of the Napoleonic Wars the lead output of the world, then derived chiefly from Great Britain and Spain as had been indeed the case for very many centuries previously, amounted to some 50 thousand tons. This increased, during the first great industrial revival from that war period, to a total of about 100 thousand tons around 1835. By 1850 this had been increased to about 140 thousand tons a year. At that date Great Britain still accounted for about half of the total, and Spain for one quarter. Of the other countries contributing lead, the United States and Germany each made about 20 thousand tons; while Austria and several other European countries made far smaller tonnages. The American output of that date was chiefly from Illinois, Wisconsin, Iowa and Missouri.

In the decades after the American Civil War the western states began to turn out lead heavily, in connection with silver mining. The world's output of lead, which had increased in total roughly in sympathy with development of other industries, amounted to some 300 thousand tons in 1885, of which the United States contributed a little over a third, and Germany a little less. Spain was in third place, and Great Britain fourth, the latter making at that date only some 12 per cent. of the world total.

The next decades were marked by the further growth of American output, the entry of Australia as a lead producer, the rehabilitation of Spanish output, and the growing importance of Mexico. In the years before the World War

the total lead output of the world ranged from 900 to 1200 thousand metric tons. Of this the United States normally furnished about 30 per cent., while Spain, Germany and Mexico produced from 10 to 15 per cent. each, and Australia only slightly less. The five countries named, for many years, produced together around 85 per cent. of the total supply of the world.

The commercial uses of lead have not broadened during recent decades as rapidly as have those of some other metals. It enters trade for use as pigment, shot, pipe, as a component of a number of alloys, and as acid-proof lining for various chemical and metallurgical processes, and in storage batteries. In some of these uses it will be seen that the lead is required by growing industries for which a growing demand may be expected, while in others it is used in ways which show little tendency to increase faster than the normal growth of population.

Lead has a unique mining and metallurgical position, which serves to throw some light on its always difficult commercial status. In most mining regions this unfortunate metal is largely a by-product, turned out casually in the mining or refining of other metals, and particularly in the production of silver and zinc. The cost of lead production is therefore chiefly a matter of book-keeping, and the amount of lead produced depends in large part on the current demand for silver or zinc. Under these circumstances there are always great possibilities for trouble in the lead market. Mined for itself alone, there might at times be some deficiency in the current supply, and some natural tendency for a temporary or even permanent rise in price. But as matters stand now, the case seems to be all the other way. Lead prices are commonly maintained with some apparent difficulty, and whenever any largely increased demand for either zinc or silver results in greatly increased outputs of these metals, the incidentally increased lead supply is frequently in excess of the normal demand

for that metal, and tends to cause instability of lead prices. In any case we need no fear as to exhaustion, in the near future, of our supplies of lead.

Zinc. Unlike lead and copper, zinc has a very short industrial history *as* commercial metal, for there was no broad use for metallic zinc until the last century. Zinc ores, however, had been used even in times of remote antiquity for addition to copper in order to make the alloy brass. But during all the early periods the alloy seems to have been always made in that way, by addition of an ore, and not by use of the metal itself. When trade to the East Indies became common, however, during the seventeenth century, zinc metal appears to have been one of the occasional products reaching Europe; and at a little later date the production of metallic zinc was taken up at various points in Europe.

Around 1850 the world's zinc output amounted to some 50 thousand tons, of which 60 per cent. came from Prussian Silesia and 30 per cent. from the Moresnet region of Belgium. The remainder of the supply was made in Russia, Wales, Austria and the United States. From this level the output increased steadily to 300 thousand tons in 1885 and over one million tons in 1913. With this vast increase in output there was less change in producing localities than was the case with most other metals during the same period. Just before the World War, for example, Belgium still produced 20 per cent. of the total, and Germany 30 per cent. The United States, however, was making slightly more than Germany. In 1850 two countries produced together 90 per cent. of the world's zinc output; in 1913 these same two countries, plus a third one, produced almost the same proportion of the total. This concentration of supply goes far toward explaining some of the earlier munitions difficulties of the Allies, because it is seen that, within a week after the declaration of war, almost exactly three-quarters of the zinc smelting capacity

of Europe was in the hands of the Central Powers, and as the zinc smelters of England were run on Australian ores a large fraction of the remaining Allied output was in danger of being cut off. From this resulted, when the situation was finally understood by the War Office, the pressure on American and Colonial production in order to make up this deficiency. How that pressure was responded to is a matter of our own recent industrial history, though some of its incidental results were most strikingly shown on the Stock Exchange.

Zinc, like quicksilver, is a metal with two names, one of which tends to be used in trade and the other in technical work. For several centuries metallic zinc has been dealt in commercially under the trade name of "spelter." There is no particular reason for continuing this usage, and it is to be hoped that it will die away in the near future.

In considering the future of the metal, both as regards output and prices, it is necessary to recall that its present chief utilizations are along the lines of galvanized wire and sheets, of battery zincs, of brasses, of pigment and in form of zinc compounds in various chemical and metallurgical processes. The many points of contact thus established between the zinc supply and the prosperity of a number of important industries tends to give demand for zinc an increase almost directly proportionate to those for iron and copper. In the future, which for many reasons we may assume will show greater developments along chemical than along mechanical lines, zinc may assume even greater importance than it has at present.

No definite estimates are known to have been published regarding the available supply of zinc ores, but so far as can be judged from commercial conditions over a long period of time, the demand for zinc is expanding, on the whole, somewhat faster than new ore supplies are being brought to light. This condition has been marked recently by the intense pressure due to the European war, when a

large demand for immediate supply of zinc metal fell on a world which was temporarily deficient in smelting capacity. In the course of filling this demand, smelters were overbuilt and mines were over-developed. Just at present, therefore, the visible supply both of metal and of ore seems too great for the peace demand — but this condition may be changed in the course of the next great period of industrial activity, whenever that may come.

A sharp distinction must be made, and kept in mind, between the geographic distribution of the world's metallic zinc output and the distribution of its supplies of zinc ores. In an earlier paragraph it was noted that the zinc output was very concentrated, three countries producing most of the metal. But this concentration of the industry was due in large part merely to trade habit, such as made Swansea the important copper metal producer of the world long after the local ore deposits had much remaining importance. Zinc ores are really pretty widely distributed over the earth and few countries would have to depend on imported ore for their metal supply if it were worth while developing local smelting industries.

Tin. As a commercial metal, tin has a very respectable record from early antiquity, for as early as 4500 B. C. tin-copper bronzes were widely used in Egyptian ornaments and weapons. Copper, and probably gold, preceded tin in human use; but one of the real difficulties in early history, which no antiquarian has bothered to explain, was how such an unusual alloy as bronze could appear at such an early stage of civilization. It is possible that it was at first made, not from a mixture of metallic copper and metallic tin, but from one of the ores in which copper and tin both appear. However that may be, the use of tin seems to have preceded that of iron in Europe and Asia by many hundreds and thousands of years.

The earliest tin supply was probably drawn from the eastern Mediterranean regions, but Cornwall soon became

of trade importance. Throughout the centuries, until the close of the eighteenth, Britain remained the principal source of tin supply for the European world. The Cornish output is known to have grown up slowly to about one thousand tons a year by 1650; there was increased demand as the eighteenth century came in; and during the Seven Years and Napoleonic Wars the output of Cornwall rose to several thousand tons annually.

After a temporary relapse in the early decades of the nineteenth century, a falling off noted in all industries from 1810 to 1825 or so, the growth of the tin output was resumed, and by 1850 it had reached some 5000 tons. The next decade, however, witnessed a remarkable gain in output, together with a rapid rise in price; and this stimulated development of tin deposits elsewhere in the world. The increased demand was due largely to the use of tin, both in bronzes and as a lead-hardener, in the re-armament which took place during that decade in Europe. The Crimean, Italian, American and Prussian wars aided to keep demand active and prices high for two decades. Then, after the long business depression following this series of wars, a new demand for tin arose. This was a demand independent of war use, for the canned provision trade had commenced its remarkable development which is still in progress.

In the years 1850 to 1900, the price of tin ranged from 15 cents a pound in depressed periods to 35 cents a pound during boom years. During the past two decades, however, a new and higher range of prices has been established, and this does not seem to be entirely due to general rise in the price level but to a growing scarcity of tin itself. The world's output of tin had increased from a total of 38 thousand tons in 1880 to 120 thousand in the years just before the World War. Its rate of growth was therefor very markedly slower than that of iron, copper or other commercial metals, and the disquieting feature was that

even years of high prices failed to induce any large increase in the supply later.

The sources of commercial tin are relatively few. During the past forty years the Federated Malay States have always contributed from 40 to 60 per cent. of the total output, while Bolivia and the Dutch East Indies furnish each about 20 per cent. Australia and Cornwall are the only remaining producers whose output enters world's markets in any serious way, though the Chinese supply, consumed locally, is probably larger than either.

Of the great producing areas, Bolivia is the only one which has shown a steady growth in output during recent years, and the main hope for any large increase in future supply seems to lie in the Andean regions. The Dutch Indies and the Malay States show little tendency toward increased output, even during or after years of high prices, and it is possible that both have passed their maximum of trade importance. In both cases, however, there are great possibilities of improvement in technical conditions, and the application of dredging methods in the Malay States is a step in this direction.

Among the minor producers of tin some are old and slowly dying districts, like Cornwall and the smaller European regions; others, like Australia, produce a certain tonnage but with little promise of large future increase; still others, like Alaska, are relatively new producers whose future is still uncertain.

But among them all there are none which give any remarkable promise; none, that is to say, which give reason to hope that in future they will replace the Malay States in importance. Unless some new sources of supply appear the tin output is not likely to increase like that of other commercial metals.

As a matter of fact, tin seems to be really a very scarce metal, far scarcer than its current commercial prices would indicate. The original deposits of tin ore in hard rock are

commonly of very low grade, and it is only the occurrence of placer or stream deposits of tin ore which have kept down the price of tin within its past range. As these placer deposits are finally exhausted, unless they are replaced in the industry by new and important deposits elsewhere, or by great increases in Bolivian or other lode mines, the price of metallic tin must continue to increase. Indeed, if the demands of the supply grow as fast in future as they have in the past, the increase in tin prices may be very marked indeed, for at present there are no deposits in sight which give promise of affording largely increased tin supplies at present prices. The adaptation of aluminum to containers may be the final way out of this impasse.

Quicksilver. The metal quicksilver, or mercury, has long been known and utilized in various forms. Its two most extensive industrial uses — for recovering gold and silver and for gilding — were practised by the Romans and throughout the Middle Ages. With the discovery of the American silver mines the amalgamation process took new life, while on the other hand the use of mercury gilding fell off after electro-plating methods were discovered, since these latter were safer and more economical. From the commencement of Spanish operation in the sixteenth century, of the Mexican and Peruvian silver mines there was a steady increase in the metallurgic demand for quicksilver. This reached a maximum, relatively to other industries, in the period 1850–1870 when the discovery of the California and Australian gold deposits and the Nevada silver ores made increased quicksilver output essential.

The older European production of quicksilver was from Spain and Austria, and at the close of the Napoleonic wars the combined output was at the rate of around 1200 tons annually, of which 1000 tons was contributed by Spain. By 1855 the world total had about doubled, the bulk of the increase being furnished by the opening of quicksilver mines in California. This increase continued at a slow rate,

but before 1880 a world total of around 4000 tons annually had been reached, and this has not been much exceeded in the four decades that have followed. There was in reality a slow but steady decline in quicksilver output, from the late seventies on, the total falling to around 3200 tons by 1885. From an extreme low point in 1891, however, the output very gradually rose to a new maximum of 4200 tons, only to fall again below 3000 tons in 1907. Since this last date there has been another slow and very small rise in output, bringing the current annual production again a little above 4000 tons.

The world's output of the present day is still derived from much the same sources as seventy years ago. Spain accounts for two-fifths of the total, and Italy, Austria and California for about one fifth each, varying a little in output and rank from year to year.

For a decade preceding the war quicksilver prices fluctuated around $40 per "flask" of 75 pounds, or about $1000 to 1500 per metric ton. If it had not been for strong international control, there is no way of determining how low quicksilver could have fallen in price. The war of course caused a rapid advance in price, but the war is now over.

Though deposits of quicksilver or its ores are worked in relatively few localities at present, there are many regions, particularly in western America, South America and Asia, where additional supplies could be developed if the necessity arose. Under present conditions the difficulty with quicksilver is not existing or future scarcity, but the securing of a remunerative price for the salable output in ordinary times. Unless some unexpected new demand for mercury comes to light, it is possible enough that it may be classed with lead as a metal likely to show lower rather than higher prices in future.

The situation as regards quicksilver ore reserves seems to be that, though not very large in absolute tonnage, they

are more than ample for the existing demand, or for any demand that seems to be in prospect. If we had any reason to think that quicksilver would find some new or newly enlarged chemical or industrial use in the near future, so that there might perhaps be an effective demand for 50 thousand tons of mercury annually by 1930, it would be difficult if not impossible to meet this situation from known ore deposits. But actually the quicksilver output increased only 18 per cent. during the last active decade, and unless this rate changes markedly the demand around 1930 will not exceed six thousand tons a year, and may indeed be less.

Nickel. We may profitably turn from an old and apparently dying metal to one whose recent growth promises a very much more important future.

Metallic nickel seems to have been known in China for centuries, reaching trade in the form of a copper-nickel-zinc alloy or bronze. But its European history is much shorter, the earliest European production of metallic nickel not dating back a century. This earliest output was from Germany and England, and the ores used as a basis were chiefly from Hungary and Norway. With the invention and rapidly increased use of the copper-nickel-zinc alloy called argentan or German silver, and with the adoption of copper-nickel for subsidiary coins by many nations, the nickel industry became more important. From a total of less than one hundred tons annually around 1850, it rose to some 600 tons by 1880. So far the sources of ore supply had not been changed.

From 1880 onward the nickel industry was marked by increased output, increased ore supplies, and new uses for the product. The French colony of New Caledonia began shipments in the late seventies, and by 1888 the world's nickel production amounted to some 1700 tons, of which almost 1500 was derived from New Caledonia ores, smelted and refined in Germany, France and England.

During this period the price of metallic nickel was declining steadily, from three dollars a pound in the seventies to not much over one dollar by 1882, and to around 60 cents a pound during the later eighties.

In 1889 a new nickel ore supply began to reach the market, that from the Sudbury field in Ontario, Canada. Within three years this became a very important factor, exceeding the shipments from New Caledonia, and effecting such a sudden change in the industry that the metallic nickel output more than doubled, from about two thousand tons in 1889 to five thousand by 1891. This growth ceased for a time, for the business of the world was passing through the depressed period which did not culminate until 1897, and during these years the world output of nickel remained almost stationary.

With the resumption of world-wide business activity after 1898, the nickel industry progressed at more than the average rate, and the world output reached over ten thousand tons by 1903. Of this about three fifths was produced from Canadian and two-fifths from New Caledonian ores. The countries in which the world output of metallic nickel was refined were the United States, Great Britain, Germany and France. Of these the United States refined over half of the total.

During the decade which followed, down to the commencement of the World War, the nickel output increased to over thirty thousand tons annually. At the commencement of the war Canada was furnishing the ore for almost 25 thousand tons of this total. The first year of the war depressed the industry, but when it was finally understood that a war required munitions the nickel industry was one of the first to be affected, and before the end of the war the Canadian output had doubled. Part of this Canadian increase went to take the place of New Caledonian shipments, which were naturally uncertain, but the remainder went to increase the total metallic nickel output.

In any consideration of the future of nickel, we must recall that during the last few decades its industrial applications have broadened amazingly. Its chief uses are now no longer in ornamental alloys, but in nickel-steels and other alloys of engineering importance. The promise seems to be for largely increased demand, and to meet this the Canadian and New Caledonian ore deposits are ample to guarantee supplies for many years to come. In addition, as a source of alloy-steels, we have such ores as the Grecian and Cuban iron ores, containing appreciable nickel contents.

The minor metals; summary. In the preceding discussion of the commercial metals, other than iron, which enter prominently into industrial development, there has been an intentional and necessary suppression of all purely technical detail, whether relating to the geology and working of their ore deposits, their metallurgy, or the statistics of their trade position. It has been desired simply to summarize the chief factors relating to each of these metals which serve to throw light on its present trade and industrial position, and it prospects for greater supply or greater use in the future of industry.

The following paragraphs summarize the chief points which seem to have been developed by this study, so far as any definite conclusions are justified. In considering them it must be borne in mind that in dealing with such a complicated problem there are large chances for error, arising both from deficiencies in present knowledge and from the personal equation. My own idea is that the greatest chance of having drawn erroneous conclusions is in regard to the future trade relations and prices of the two metals lead and zinc, where the data as to ore reserves have never been put on a clear and definite basis, and where the commercial conditions are very complicated.

Under these limitations we may summarize the matter as follows:

1. Of the metals discussed two — aluminum and nickel

— promise future growth much more rapid than the average. Both have ample ore supplies to carry out this growth.

2. Copper and zinc demand should grow, in future, at least as fast as the demand for steel, and perhaps somewhat faster. In both cases a largely increased demand may throw some strain on known ore deposits. This would induce a normally higher range of prices for these two metals, if this effect is not masked by lower general commodity prices.

3. Tin seems to be getting very scarce during years of good trade, and unless some new sources of ore supply are discovered will probably not be produced in sufficient quantity to fill the demand. In some of its uses it may be replaced by zinc; in others by aluminum.

4. Lead has an uncertain commercial position, and there seems to be rather more danger of future over-production than of scarcity.

5. Quicksilver shows little sign of increased demand, and is likewise in chronic danger of over-production.

Taking the minor commercial metals as a group, there is only one of them whose supplies or future prices may cause difficulty. The others seem to be present in sufficient quantity to permit a large increase of use, while two of them appear to be just at the beginning of their real usefulness to industry.

CHAPTER XIV

CHEMICAL AND STRUCTURAL MATERIALS

The two groups of manufacturing raw materials which remain to be discused are the chemical raw materials and the structural materials. These two differ widely in their industrial importance and in their probable future growth. The first, including the raw materials used as a basis for the chemical industries, will in all probability show in future a rate of growth even faster than that of the steel industry, with a more widely developed range of products each decade. Most of the structural materials, on the other hand, tend to exhibit a rather slow rate of growth in output, which on the average may be not much faster than the rate of increase of population.

Chemical Raw Materials

The groups of raw materials discussed in preceding chapters represent to a large extent the past and present of industrialism, while the group now to be briefly considered represents its future. For, whatever we may think as to the future rate of growth of the steel industry, for example, we are running little risk of error in assuming that the growth of the chemical industries will be still more rapid.

We have already noted, while discussing the uses of coal, the great and increasing important chemical industries which utilize it as a raw material. In the present place we may therefore confine attention to the heavy chemical industries, which supply the chief acids and bases used in the manufacture or treatment of later products. These are derived, in very large part, from natural mineral raw materials.

The chief bases used in the chemical industries are lime,

magnesia, potash and soda; and their necessary supply is secured by treatment of limestone, salt, and certain natural potash and magnesian compounds. The chief acids — sulphuric, hydrochloric and nitric — are also secured almost exclusively from mineral raw materials, some of which at the same time furnish a useful base in addition to the acid. In addition to these purely chemical raw materials, used in further manufacture, some attention may profitably be paid to the question of phosphates, because of their direct influence on food supplies and indirect influence on future industrial development.

Sulphur. The sulphuric acid supply required by the chemical industries of the world is derived from three distinct but related sources. There are, first of all, certain deposits of native sulphur in the United States and elsewhere, and some of these are very large and very cheaply operated. Second in importance at present, from a commercial standpoint, is the supply of sulphuric acid derived by roasting iron pyrites specially mined for that purpose. Third in present importance, but perhaps first in its future effects on the industry, is the large and growing supply of acid obtained as a by-product from metal smelters and reducing works of various sorts. This last source of supply will be developed more extensively each year, and the prospects are that in future sulphuric acid will reach a lower range of prices than it has in the past.

In order to get some idea of the present relative importance of the three sources of sulphuric acid, we may note that of the three million tons of acid produced in the United States, a little over half is made from domestic and imported pyrite, about one quarter from domestic sulphur, and about one fifth from smelter gases.

As to the supplies of original raw materials, that of pyrite is very widely distributed, while sulphur is more closely localized. Of a world output of some three million tons of pyrite annually, Spain commonly supplies close to

one million, while Norway, Portugal, United States, France, Italy and Germany each produce from 200,000 to 400,000 tons, the remainder being widely scattered. The sulphur supply is of around nine hundred thousand tons: Italy furnishes over half, and the United States most of the remainder, with Japan as the only other serious producer.

Nitrates. The world's supply of nitrates, for use in the manufacture of explosives, fertilizers and other chemical products, is now derived almost exclusively from the deposits of natural sodium nitrate in northern Chile. These deposits are large, as compared with current demands, and even the best efforts of a monopoly supervised by the Chilean Government has not been able to do more than keep output and prices under some small degree of control. In ordinary times the Chilean deposits can swamp any possible competitive supply, and knowledge of this fact has in the past operated to prevent the development of smaller and less well-located deposits which are known to exist elsewhere.

The Chilean deposits have, however, one marked defect which was brought out sharply during the World War; and which would appear in still more disastrous form in case of a war between the United States and any power having an active surface or submarine fleet in the Pacific Ocean. The defect is that the distribution of the output is entirely by sea, and that the steamers carrying the nitrate must make a long run along open coasts. We must therefor consider that nitrate, though the natural supply is more than ample, is likely to be entirely cut off during war conditions.

In default of a supply of Chilean nitrate, a country would have to fall back upon either (a) local supplies of natural potash or soda nitrates, (b) nitrogen extracted electrically from the air, or (c) nitrates manufactured from coal or lignite. All of these modes of securing nitrate supplies are technically feasible, and none are absolutely pro-

hibitive as to cost under war conditions, though in normal times none of them can at present compete with the natural Chilean supply.

Salt. Common salt, or chloride of sodium, occurs in the form of extensive natural deposits in many parts of the world; and its supply in this form is practically unlimited as compared with the demand. Further than this, however, there are in many regions brines or natural salt waters which can be evaporated profitably even under ordinary trade conditions. Finally, even ordinary sea-water can be used as a source of commercial salt under favorable climatic conditions. So that there can be no possibility of a scarcity in the supply of this very important chemical raw material, and its future prices are likely to range in close accordance with the general trend of commodity prices.

The actual salt output of the world is also widely distributed, the United States leading with some four million tons annually, followed closely by Germany and Great Britain, and these in turn by numerous others. The output of salt, all over the world, increases along with the growth of the chemical industries, but the foreign trade in salt is of less and less importance, relatively to the total. The reason for this is clear enough, for a country cannot base a large chemical industry on bought and imported salt supplies; either a native salt supply is developed, or the chemical industry fails to grow.

Lime. The most important of the bases used in the chemical industries is lime. This is normally derived from the burning of limestone, and as that rock takes up a very large proportion of the crust of the earth there is no danger that we will ever run short in supply.

The quantity of lime used as a chemical raw material, for one use or another, is very doubtful; it may amount to three or four million tons as a world total. It enters into the chemical trades not only in the manufacture of the heavy chemicals, but through its uses as a chemical

reagent in a number of entirely different industries, such as the paper, leather and sugar manufactures.

Potash. In dealing with potash, we come again as in the case of nitrates on a material whose normal commercial supply is very large but also very closely localized geographically. The commercial output, used like nitrate chiefly for fertilizers and explosives, is derived almost entirely from the deposits of natural potash salts in the former German Empire. The German Government did its best to restrain over-competition in the output of these deposits, but they are so large and so cheaply operated that even a Government-aided monopoly found it difficult to keep the output down and the prices up. It is merely another proof of the fact that durable monopolies must be based, in the last analysis, on natural scarcity; and that even an autocratic government can not do much in the way of holding up prices in the face of an over-abundant natural supply.

As with nitrates, substitute supplies for European potash could be furnished during war times, these emergency supplies coming from various mineral or vegetable raw materials, and during the World War this was done to some extent. The chief possible sources are certain rather common minerals — glauconite, feldspar, etc.— and some of the seaweeds. If there were any guarantee that future potash prices would be high, or if the government continued to aid development by duties or by direct subsidy, some of these alternative supplies could be kept in action during peace times, as a guarantee against future contingencies, for the technical features have been worked out successfully enough.

Phosphates. Extensive deposits of lime phosphates in one form or another are found in many parts of the world. As the higher grade or more available parts of these natural deposits are gradually worked out, there may be increased prices for the product, but the natural supply of low-grade

phosphates is so large that the question of final exhaustion need not enter.

More important, however, as affecting the question of future phosphate supply and prices, are the developments which may fairly be expected from the steel industry. The cheapest and easiest way of making a good fertilizer, after all, is by treating high-phosphorus pig iron in either the Bessemer converter or the open-hearth. The slags thus produced have been for a number of years an important item in German and English trade, and as the steel industry develops along more economical lines we may reasonably expect to see a much greater growth in the manufacture of phosphate slag as a by-product.

There is an interesting and important point about the geographic distribution and the national development of phosphate rock supplies which usually escapes notice. Though the raw material in one form or other is really very widely distributed, the commercial output is practically all in the hands of two nations. Of the six million tons of phosphate shipped during normal years just about half comes from the United States and the other half from France and French colonies.

Structural Materials

There are three main groups or classes of structural materials of mineral origin used by the engineer, in addition of course to the iron and steel which have previously been considered.

The classes now to be noted are (1) clay products used structurally, such as brick, tile, etc.; (2) cementing materials, including Portland and other cements, lime, plasters, etc., and (3) building stones.

Of these three classes the building stone is used in natural condition, while the clay products and cementing materials have undergone some degree of manufacture before being fit for engineering use. But in all three cases the raw

materials used are natural rocks, such as limestones, clays, granites, slates, etc., which make up enormous beds or masses, and are widely distributed over the earth's surface. There is no possibility of actual exhaustion of any of these materials, and except locally there is no danger of such scarcity as to cause rise in price. The danger is in fact all the other way, threatening the manufacturer rather than the consumer. It would be entirely feasible, from a raw material standpoint, provided a steady demand justified the erection of sufficient plants, to produce one hundred times the amount of stone, bricks or cement now annually used, without any necessary advance in prices.

PART III

THE CAUSES AND EFFECTS OF INDUSTRIAL GROWTH

CHAPTER XV

THE FACTORS OF INDUSTRIAL EVOLUTION

In the course of the historical sketch which comprised the first part of this volume, we saw that during the past century many nations had been affected, at one time or another, and to a greater or lesser extent, by a remarkable industrial development, accompanied by great increases in output of commodities, in average wealth, and in population, and marked also by great social, industrial and political changes. We have seen also that the progress was not uniform from decade to decade, but that the developments came in great waves, of alternate rapid growth and relative slow growth or even depression; and that to a large extent all countries alike were affected by these rhythmic variations in rate of progress.

There is one point to which attention must be called at the outset, and this relates to the very *fact* of industrial growth itself. We have become so accustomed now to the idea that any large country shows a steady annual increase in its output of staple goods that we are tempted to look upon this as a condition which has always existed, and which requires neither attention nor explanation. But as a matter of fact industrial growth has not always existed — there have been whole centuries and series of centuries when the production of goods showed little or no increase, and even as late as the eighteenth century there was a period of over fifty years when the basal industry of Great Britain — the iron industry itself — actually decreased in output each year.

There have thus been long periods in the world's history when there was no trace of what we are now accustomed to consider as merely normal material progress.

And in saying this we need not go back for example to the fourth and fifth centuries, when our barbarian forefathers broke through the last defenses of the crumbling Empire and demolished what of civilization they found, but to much more recent periods. Since the time of the Norman conquest of England there have been long periods during which the European production of iron, for example, was so little that it did not more than compensate for the loss by rusting and destruction during the same period, so that at its end the world supply would be actually less than at its beginning. During those centuries steady growth in output was not a normal thing in any industry, but a very remarkable and abnormal matter. To-day, though our present period of rapid and unchecked industrial expansion dates back not much over a century, we have become so accustomed to progress that we have ceased to wonder at the marvel of it.

It may therefore be novel as well as advantageous to our present study, if, instead of accepting industrial growth as a matter of course, we make some attempt to outline the conditions which cause it and the factors which have determined its recent rate of expansion.

The phenomena observed are of great extent, both geographically and chronologically, for they have covered all the continents and have been apparent, in about their present intensity, for well over a century. For these reasons the factors which caused them can not be given purely local explanations, as is so often the case when the development of a single country is considered, apart from that of the rest of the world. At the outset, for example, it was easy enough to explain the sudden development of England as being caused by the native manufacturing genius of the English workman. That explanation served for half a century, and it is still of service to British politicians, but it would hardly be accepted elsewhere as an adequate explanation. Later, when America began to make evident manu-

facturing advances, slower than commonly supposed, there was a somewhat grudging admission abroad that the native sharpness of the Yankee might serve almost as well as British genius. Still later, it was necessary to add the explanation that the plodding industry of the German also had fair industrial effects. The case of Japan offered greater difficulty, but monkey-like imitativeness was finally offered as a complete explanation of a really very remarkable phenomenon. Just what explanation will be given when China joins the group of leading industrial nations is still uncertain, but one may be sure that even then there will be many people who will try to explain it in terms of innate racial qualities.

Another widely accepted group of explanations are those which credit the advances to the forms of government enjoyed, or the governmental policies adopted. These too are very well so long as we confine attention to the progress of a single nation, but they become difficult when a broader view is taken. Can one take seriously the explanation that progress comes because we have a democratic republic, or a democratic monarchy or an autocratic paternalism when he compares the results attained under such very diverse forms of government as have been enjoyed by the United States, Japan, France, Germany and England? And what shall we say to the man who can give all the credit to specific government policies when we consider what has happened under free trade in Great Britain, under steady high protection in France and Germany, under violent alternations of policy in America?

The explanations which are so freely offered during a political campaign, and which are serviceable enough for their immediate purpose, do not after all seem to cover the case. Perhaps it would be as well to abandon pre-conceived theories, and attempt to build up an explanation from the various facts which we encounter in different industries today. The final result may be less simple than racial genius,

or protection or democracy — but it may be nearer the truth.

Causes of industrial expansion. Instead of going back to a theoretical primitive community on a desert island, and endeavoring to follow out its probable line of development, let us apply the same effort to conditions of to-day, which we can check up much more easily and accurately. We have just passed through a period of great expansion in American trade and manufactures, marked by heavy increases in output of commodities, and by a very general rise in prices. With a few minor interruptions this has lasted for ten years; with one more serious exception it has really lasted twenty years. During that period practically every American business and industry has grown, and some have grown very remarkably. If we can get some idea of the various reasons for the individual growths, it should be possible, by comparison, to come to some more definite idea as to the general causes of industrial expansion.

This result could be attained if we were to select a large number of successful American manufacturers and merchants, engaged in different lines of business, and ask each of them; "Why has your particular firm or corporation been able to increase its output during the past ten years?" The explanations given would be widely variant, on their face, but they would on more careful examination be seen to fall into a small number of pretty definite groups.

For example, many of our informants would mention the effects of the European War as increasing their markets through cutting off of European competition. Still others would again refer to the war as having created increased and urgent demand for their commodities — in such lines as munitions, shipping, oil and copper. The aluminum manufacturer might add that in addition to the absence of foreign competition, there was the high current price of copper, which permitted broader market for aluminum wire and cables. The cement maker, not affected favorably by the

war, might fairly credit part of his increased output during earlier years to the increasing cost of lumber and the consequent substitution of cement. The manufacturer of luxury goods, as silks, might explain that people were buying more expensive goods than formerly. The maker of agricultural implements would say, perhaps, that there had been good crops in the Argentine, and that steamer rates had been low until the war came. Our railroad managers would admit that, even under government regulation and temporary government control, the tonnage moved tended to increase with the increased population, and the manufacturer of coffins or of baby-carriages would give the same reason for the growth of his business. The maker of certain steel products could say that, even before the war, his lowering costs permitted him to reach some foreign markets which had earlier been impossible.

Taking this mass of partial explanations, it will be seen that they all involve either sales to a greater population, or sales at a greater rate per capita, or both. They all imply that the market for the commodity has been expanded in some way, but they offer a large variety of causes for the expansion. It may be well to sumarize these causes, not necessarily in order of importance, to clear up the results so far secured.

We may assume that in every case increase in output is caused by expansion of market, and that this in turn be due to:

a. Normal growth of population, by birth or immigration.
b. Increased consumption per capita, due to higher standard of living, to new uses for the product, or to substitution for other products.
c. Increased ease of access to broader markets, through improvements in transportation or new discoveries.

As thus grouped, the factors which tend to bring about in-

creased output of commodities appear very simple, but in reality they act and react on each other in complex fashion, so that the actual result in any given case is not necessarily obvious, and it is difficult at times to say which is the immediate cause and which the effect. For example, the development of an industry somewhere may in itself bring about increase in the local population, and the increased wealth of the community may then bring about even greater local demand for the product. The increased output would in turn bring about decreased manufacturing costs, and this would again open new fields of use for the product. Now this is not an imaginary sketch, for something like the complicated process just outlined has really taken place, during the past century, not once but many times, at many different places and in connection with many different industries. The difficulty is that, looking back over the history from a much later date, it is often difficult to get a clear idea as to the order in which these events happened.

There is one error which is frequently made in this connection, and that is as to the relation, in point of time, between the production of an article and its market. It is perfectly true that a commodity must be made before it can be consumed, but in general it is not made until its market is pretty well assured. We often speak carelessly of early industrial growth as though, at some given time, the furnacemen of England had said—"This year the British output of pig iron must be 100,000 tons. Let us develop new uses for this amount." Now in real life such a procedure would not result in the development of the iron industry, but in the bankruptcy of the manufacturer.

The true sequence of events during the early history of any industry appears to be, on the contrary, that new or enlarged markets are found, and that the output expands in order to fill the increased demand; that for a long time it is apt, because of human conservatism, to remain below

the demand; so that prices do not drop immediately as the output grows, but remain high and even increase. At some later period there is a temporary falling off in demand, with consequent over-supply and lower prices; and then the factor of new uses is likely to appear.

In any case, it will be well to consider in turn each of the three factors which have been summarized above — growth of population, increased consumption per capita, and broader markets. It will be found that all three have acted very unequally at different times and in different countries.

Growth of population. Living in the United States, in the twentieth century, we have become so accustomed to finding that the population of our country increases quite rapidly that we are apt to overlook the fact that all the world is not so fortunate even now, and that not so very long ago none of it showed a rapid growth in population. There have been centuries after centuries when the population of England, for example, was essentially stationary. There have been hundreds of years during which countries have been on so narrow a margin of safety that one bad harvest meant serious famine, and a succession of three or four bad crop years would cause a heavy decrease in the population. Thanks to improvements in storage and in transport we have now a far greater margin of safety, but it is by no means certain that the earlier conditions can not again recur.

Population can only increase rapidly when living conditions are relatively easy; and each increase of population will, so long as it works, tend to make living conditions still easier — up to the time, at least, when all the earth's surface is carefully farmed. On the other hand, each day or year of idleness or destruction throws us back again toward the conditions of the Middle Ages. The world has not yet accumulated such a surplus of supplies that it can afford

to be idle, or to be destructive. That is the real basal objection to both war and syndicalism — that they reduce productive effort, which we can not yet afford to relax.

On the other hand, so long as population increases and works, there is a steady increase in demand for most commodities, and the minimum rate of increase for any industry will tend to be fixed by the rate of increase of population. If we find that, over a series of years, our output of some special commodity is not increasing at least as fast as the population, there is something wrong about that industry — either its raw material supplies are deficient, or it is being replaced by some other product.

We may therefore accept the rate of population increase as the *minimum* at which we may expect an industry to grow, and it will be of interest to see what that means in figures.

It is convenient to use the term *normal* growth, for it conveys a sufficiently exact idea of what we have in mind — i.e. the increase in population of any country due merely to births and immigration, and disregarding such exceptional influences as wars, natural catastrophes, or annexations. Taken in this broad sense it is a serviceable term, even though it is subject to criticism in detail. For as soon as we come to examine the facts we see that there is no such thing as a *normal* rate of growth for population, but that on the contrary the prevailing rate varies from year to year, from century to century, from class to class, and from country to country.

As regards the facts, we have fairly accurate figures for later years, and very doubtful estimates for world population in earlier years, covering the past century or so. These are tabulated on page 195, for convenience in discussion.

As soon as we glance at these figures, one aspect of the situation presents itself — the rapid growth of American population relative to that of the world in general. This was in part due to the fact that the United States was a new

Year	*World population*	*Per cent. increase*	*United States*	*Per cent. increase*
1790.....	.....	..	3,930,000	...
1800.....	640,000,000	..	5,310,000	35.1
1810.....	.....	11.5	7,240,000	36.4
1820.....	780,000,000	9.5	9,640,000	33.1
1830.....	847,000,000	8.6	12,870,000	33.5
1840.....	950,000,000	12.2	17,070,000	32.7
1850.....	1,075,000,000	13.2	23,190,000	35.9
1860.....	1,205,000,000	12.1	31,440,000	35.6
1870.....	1,310,000,000	8.7	39,820,000	26.6
1880.....	1,439,000,000	9.9	50,160,000	26.0
1890.....	1,488,000,000	3.4	62,950,000	24.9
1900.....	1,543,000,000	3.7	75,990,000	20.7
1910.....	1,616,000,000	4.7	91,970,000	21.0

and unoccupied country, so that its entire growth took place during the nineteenth century. But it was in part due to industrialism, which not only permitted but encouraged this growth. The influence of the industrial factor, as distinct from that of normal growth, is shown also when we consider older countries, such as England and Germany. We find that they too showed higher rates of growth than the rest of the world, though lower than that of the United States.

England, for example, whose population had increased only fifteen per cent. in the entire century between 1651 and 1751, showed an increase of almost two hundred per cent. in the century which succeeded; her population increased as fast every ten years as during an entire earlier century; and her industrial activities permitted their maintenance in more comfort than had ever been seen before. At a later period Germany showed similar increases in rate of population increase, so that in the period 1816-1910 her population increased almost three hundred per cent. France, on the other hand, showed less than fifty per cent. increase during about the same period.

If we take, in place of the increase in per cent. per decade, the annual rate which corresponds, we find that the population of the world has increased during the century at the rate of about one per cent., compounded annually. But when we come to consider the three industrial leaders, we find increases more than double this rate, for the population of the United States, Germany and England has increased at rates ranging from two to three per cent. a year.

Obviously this increased population accounts for part at least of our increased demand for commodities, but it does not account for all of it. When we were studying the questions of coal and iron output we found that for many decades the world's output of these commodities had increased at the rate of over four per cent. annually, while the output of England, Germany and the United States had grown at a higher rate, close to seven per cent. We come therefore, to see that the United States, Germany and England have for a century or more, produced the two basal manufacturing materials at a rate which increased twice as fast as the rate of population increases. This must obviously have involved either increased consumption per capita of the home markets, or access to new markets. Actually, in all three cases, both these factors were involved in different degrees.

Increased consumption. In a world whose standard of living and whose requirements are substantially unchanged as the years go by, the increase in population will bring about a pro rata increase in manufactures, but no more than this. But if commodities produced are being continually applied to new uses, or are used more freely in old ways, there will be increased consumption per capita.

For many centuries the world did actually remain almost fixed in its standard of living and in its other requirements. Then, gradually at first but with increasing momentum as opportunity increased, there came about a heavily growing demand for commodities of all sorts, not only for

these of final use, such as foods and clothing, but for such as were to be applied in less individual and immediate ways. We rarely stop to consider just what a very large proportion of the coal and iron we produce is employed merely in transporting other commodities from one place to another — some idea perhaps can be gained if we reflect that in the United States over a third of the coal we consume is used as railroad and shipping fuel, and that the English and German proportions must be about the same.

In any case there are complex relations between the factors which are at work, for increased population not only means increased demand for commodities, but increased facilities for supplying them, and probably decreased cost per unit and an increase in the general wealth.

Expanded markets. If to the two factors already noted we add the expansion of markets, or increased ease of access to old markets, we have assembled the main factors which incite great industrial development. And it was this last factor, so far as we can tell, which played the greatest part in bringing about the marvelous expansion of British manufacturing toward the close of the eighteenth century.

The earlier part of the eighteenth century saw the acquisition, by England, of vast new markets; the closing decades of the century saw the rise of the new industrialism which was to supply them with commodities. In following out the purely military history of the series of great wars in which England and France engaged during this period, we are apt to overlook their commercial and industrial effects. To sum them up here, it need only be said that at the end of an almost continuous struggle lasting from 1740 to 1763, Great Britain was left in possession of India, Canada, and a large number of island colonies all over the globe. Considered merely as territory, these acquisitions would not have been of serious importance, but considered as growing markets, absolutely restricted under the Navigation Acts to the products of the home country, they fur-

nished a direct incentive to British manufacturing enterprise, and were thus the most important single factor in bringing about the industrial revolution toward the close of the eighteenth century. The external effects of that great change in industry have been discussed in Chapter I, and there is no need to retell the story here.

The expansion of markets which so affected England in 1763, however, was by no means the last great broadening of markets that the world has seen. In the first quarter of the nineteenth century there was the great development of the Mississippi region of the United States, and a less important development of South American markets after the Spanish colonies gained their freedom. Still later there was the very remarkable growths of Australia and California, under the stimulus of the great gold discoveries. Later still, well toward the close of the nineteenth century, new markets were opened to the world through the expansion westward of Canadian and Argentine agriculture, and the re-opening of Africa by Europeans. In all of these cases periods of world-wide commercial and industrial activity were induced, in which different nations shared unequally, because of their unequal natural advantages, or because of unequal political conditions. These other factors, which served to aid or to limit national development may be briefly noted now, in order to complete the record.

Accessory and limiting factors Given new market possibilities, they can be availed of by a given nation only if it has goods to offer and convenience of access to the market. In order to produce an extensive industrial development, new markets require that the country which enters them must possess raw materials, fuel, labor, transport, capital, and that it be not unduly hampered by its government. These matters are simple enough, but they are often overlooked, as when we ascribe the slow industrial development of Spain, Italy, and South America to racial, political or religious conditions. It is not the presence of the Church,

but the lack of Coal, which has most hampered their development along modern industrial lines.

During the past century some of these factors have increased tremendously in importance, while others have become relatively less important. Prior to the perfecting of the steam engine, fuel was of trifling importance to a nation, so far as its manufactures and foreign trade were concerned, for coal did not until near the end of the eighteenth century become of importance for either factory fuel or for transport power. But after that perfecting of the engine, coal became the most important single factor which served to aid or limit industrial expansion, after new markets had once furnished an incentive for such expansion.

Further, the adoption of steam transport and later of iron ships, though they aided the whole world by furnishing cheaper food supplies and lower freights, gave still greater importance to the country which possessed fuel and could make iron cheaply. In fact, from 1780 onward, there has been a steady and progressive differentiation going on, in wealth and power, between the coal-producing and the coal-importing countries. So far as we can see, this factor will continue to act in future with no less strength, and perhaps for a time in still greater degree. In our discussion of the coal supplies of the world we saw the reason for this condition, and noted some of the way in which a cheap fuel supply operates to increase national power.

While conditions as to fuel supply, raw material supply and transport became of increasing importance as time went on, the political factors became generally of less importance in their relations to industry. During the greater part of the nineteenth century it could not fairly be said that government action had aided very strikingly in any nation, while on the other hand its evil effects were often seen. But this condition is not likely to endure, for with the increasing inter-dependence of industrial, social and political interests we may fairly look forward to an increasing amount

of government regulation in all lines of activity. The trend in this direction became noticeable late in the last century, as we will see later in discussing the progress of political beliefs (Chapter XXI) and their effect on industrial development, and the World War has rather increased than lessened the tendencies in this direction.

We have spoken, so far, much as if industry had been mentally and technically stationary during the past century, and as if its progress had been merely along the line of wider markets and increased output of commodities. But this, as we all know, would be a very unfair statement of the case, for one of the most striking facts about the nineteenth century was its great progress along technical lines, resulting in the rapid adoption of new processes and methods, and the fabrication of entirely new products. It will be well to turn to this phase of the question, and try to get some idea of the extent to which this progress in discovery and invention came to the aid of the manufacturer and of the world in general. This last qualification is necessary, because if we look upon industrial development as a matter complete in itself, and of interest only to the laborer and the employer, we are missing the most important part of our story. There is already too widespread a tendency to think of events only in terms of their effects on the fortunes of some particular labor organization, or of some particular manufacturing corporation. It is time to think of their effects on the nation as a whole.

CHAPTER XVI

THE PROGRESS OF INVENTION AND DISCOVERY

In discussing the progress of invention and discovery during the period of modern industrialism, an attempt will be made to get away from a purely chronological record of mechanical improvements, and to arrive at a somewhat broader view of the subject we have in hand. It is easy enough to set down a list of dates, covering the invention or adoption of important processes and machines, but when we have done this we have not really gone very far toward understanding the changes that have come about during the past hundred and fifty years, or toward reaching any well-founded ideas as to the possibilities and direction of future changes. Yet unless we can do this last, most of our time will have been wasted, for a purely historical study is of no possible value if it does not serve to throw some light on the conditions of the present and the probable conditions of the future.

Putting the problem in its most general terms, so far as purely material conditions are involved, we see that the world of 1920 produces a far larger amount of commodities than did the world of 1770; that it supports a far larger population; and that because of lowered prices the commodities produced are shared far more evenly among the elements of the population. The food supplies are larger and more certain, and in many other directions man has been able to overcome natural obstacles which had formerly served to limit his material advancement. Some of the factors which have aided to bring about those new conditions may now be considered more carefully. The first which comes to attention, of course, is the vast increase in power which is now at our service.

Increased mechanical power. The entire world of 1770 may have had, so far as we can calculate now, some five hundred millions of population, or roughly one third as many as it is supposed to have to-day. The power available for work, has however, increased in a far greater ratio, and this fact has affected all of our mechanical activities. In 1770 the total power available was that of human beings and draft animals, plus a few small water powers, plus of course the fraction of wind power developed by windmills and sailing vessels. If we assume that two-thirds of the world's population was capable of useful work, and if we make some still cruder assumptions as to the animals, mills and vessels then in existence, we come to some such figure as eighty millions horsepower as being the absolute maximum possibly available at that date. To-day the steam and hydro-electric power utilized in the world must aggregate around one hundred and sixty million horse power, so that our mechanical power alone is almost double the total world power which could be developed in 1770.

The new power thus placed at our disposal has certain features of interest aside from its more total quantity. It can, for example, be utilized in large units, so that many mechanical achievements are now easy enough which a century or two ago would have been impossible because of their sheer bulk. Further, the new powers can be applied to transportation by sea, land and air, in ways which were entirely impossible when man and animal power were alone available. The net results are that we can produce and transport raw materials and manufactured products in larger quantities, in less time and at lower cost; so that the finished product can reach wider markets and at lower prices.

Not all the new power available is used to increase quantities and lower costs, however; a very large proportion has been used in reducing the amount of human labor employed in physical work. During the century and a half of our

machine civilization these effects have become so great that a very large percentage of the population has been entirely released from hard physical labor, while the working time of the remainder has been reduced from twenty to forty per cent. Now these are changes which must be credited directly to modern industrialism, and they have been made possible only by increased technical efficiency in all the manufacturing processes. Further reductions in human labor per ton of output must depend, as in the past, on further improvements in processes, not on laws or social programs.

As regard the technical advances which have been made during this period, these which relate to the development and transformation of power are many in number and great in importance, but for our present purposes we may simply note a few of the main lines of progress. Taken roughly in order of development these were the steam engine, the water-power turbine, the electric dynamo, the gas-engine, to which perhaps we might fairly add the steam-turbine. Of these, the steam-engine had the entire field for over half a century, from the early work of Watt in 1769 to the beginnings of work on water turbines and dynamos around 1830. It had indeed a longer time than that commercially, for it was not until after our Civil War that the dynamo was perfected and the internal combustion engine made effective. So we may give the steam engine an uninterrupted field for practically a century, before attention was seriously turned toward its rivals.

During this long period the growth of steam power was steady and very great. We can fairly assume that it started from zero in 1770, for the old Newcomen engines then in use were not serious in number nor in total power. Within a hundred years there were eighteen million horse power developed by steam engines in Europe and America, and by the close of the nineteenth century this total had risen to over seventy million horse power.

The different uses to which this new power was put show some very interesting changes in relative importance. At first the great demand was for manufacturing power and all of the early power was turned in that direction. But gradually steamships came into use, and then locomotives. Mulhall estimates that of the 1650 thousand H.P. available by 1840, half was used as stationary or manufacturing power, almost a third by railways, and the remainder by steamers. By 1870, however, the railroads were taking two-thirds of the total power, and manufactures only a quarter. Our own estimates covering current conditions, as given in Chapter IX are perhaps a better guide, since being based on coal consumption they automatically make proper allowance for the fact that mill engines are in more constant service than locomotive and marine engines. We saw there that at present about one quarter of our steam power is used on transportation, and over half in the manufacture of commodities.

What we rarely realize, in considering the early steam engines and steam machinery, is the excessive badness of the shopwork which was then customary. In those days, and indeed even until the decade of 1830-1840 when Whitworth worked out his great advances in machine tools, there was no way of making a really plane surface except by continuous trial and error. The shop had no planing machines of any sort; it did have very crude lathes, and equally crude drills; other than these, hand tools and a rule divided into eighth-inches were the only appliances available. Under these circumstances we need no longer wonder at the roughness of the early engines and power machinery; the only wonder is that it ever could be induced to operate at all. We find Watt, for example, congratulating a client on getting an 18 inch cylinder which was bored so accurately that it was not over three-eighths of an inch out of true. And this was really wonderfully good shop practice for 1800, and not very bad practice for 1825. In the early days it

might take several months to coax a steam engine to run, after it was finally erected; it might, indeed, refuse to run at all, no matter how many old hats or papers were used to stuff the leaky places in the cylinders.

Next in importance to steam comes the question of electric power. This is, in its real commercial applications, a matter of barely more than the last half century, for until the dynamo was perfected there was no adequate source of cheap electric power, and electricity could be utilized only in some of its minor industrial possiiblities such as the telegraph and electro-plating. With the coming of the dynamo, however, it was possible to develop electric power in any quantity required, from initial steam or water power.

We sometimes overlook the fact that the very rapid development of electric power, in the decades after our Civil War, was due to certain advantages which had not been existent when steam power was being slowly developed. The more obvious of these factors which aided the later industry were the facts that all our metals were vastly improved and greatly cheaper, and that our shopwork was immensely superior to that possible during the early days of the century. In discussing steam power some reference has been made to this later point, and it can be seen immediately that electric development might have been very slow if it had been compelled to struggle with meters and dynamos made as crudely as were the early steam-engine parts. But there was a further advantage to the later developed industry, and this arose from the great advances that had been made in pure science, notably in chemistry and physics. It was no longer necessary for the machine maker to proceed by guess; he had very definite rules at his disposal, worked out by the scientist from laboratory experiment. So we find that, in fact, many of the great electrical inventions were made, not by men in the industry, but by scientists in universities and elsewhere.

Aside from its uses in power and lighting, which are

most obvious, an increasingly important utilization of electricity is in the chemical and metallurgical industries, and this use is likely to become still more striking in the future. At present we need only note that our aluminum production, our atmospheric nitrogen and calcium carbide, much of our alkali and much of our metal-refining are dependent upon the large-scale production of electricity.

We need only note, without discussion, the other important power developments of the past century — the water turbine, which makes hydro-electric power possible; the gas or internal combustion engine, our most economical way of using fuel to produce power; and the steam-turbine, most effective mode of employing the power of steam. All of these will be of increasing future importance, but none could have the completely revolutionary effect that came with the first crude but practicable steam engine.

Transport and communication. Passing from questions of the development or transmission of power to that of its utilization, first place may be given for many reasons to the matter of improvements in transportation.

The world of 1750 was more limited in this regard than we are apt to realize, and it would be difficult for an exploring expedition to-day to find a place as badly off for transportation as were France and England then. Despite popular romances as to the duration of the old Roman roads, they did not as a matter of fact exist in seventeenth or eighteenth century Europe. There were sailing vessels on the seas and along the coasts; there were practically no canals or good roads; the inland transport was effected by pack animals or carts; and the horses used were of a grade which could not be sold for beef to-day.

What this meant in the way of transporting food or other commodities is hard to comprehend. We may assume, I think, that in Europe of 1750 the average cost of transporting a ton of anything to market, roads and cattle considered, must have been well over fifty cents a mile in

our present currency. The meaning of this, as regards food supplies and famines we will consider later. Here we need only think of its effects on the production of other commodities, and see how these limiting conditions were gradually improved under the new industrial regime.

If I am right in my cost estimates, it is clear that a manufacturer ten miles away from his main market in 1750 would have been as badly located as if he were five hundred to a thousand miles away from it to-day. Under such conditions there was obviously no inducement for a great industry to build up around a supply of raw materials, unless that supply happened to lie very near a good market. There was in fact no inducement to build up great units anywhere. The natural course for industry to follow then was to have a large number of small units, each located near to a good market. The only exceptions to this rule would come from small groupings around a water power, in the rare instances where power would be cheap enough to compensate for distance to market; or the more important concentrations along the lower reaches of a navigable river, where the question of transportation to market became simpler. Other than these — very small groups of workers, or better yet, household manufacture.

The first improvements in transportation came, indeed, before the new industrialism had found its new source of power; and they took the lines of real roads and of canals, both in England and in France. During the decades 1750 to 1780 there were vast improvements made in both directions and in both countries. There is a history of grimly humorous type relative to one of these early English canals. When its construction was undertaken the laborers of the region gathered, with petitions and riots. Their protest was not against the canal itself, nor against the introduction of machinery, for as yet there was no machinery to introduce. The ground of the protest throws some much needed light on the condition of labor at the time, and may be com-

mended to the attention of those who believe that the later introduction of modern industrialism wrecked a previously free and happy laboring class. It was simply this; the laborers had heard that when the canal was completed horses were to be used instead of men to pull the boats; and they protested because this would cut down their chances of work.

After the steam engine had once been put into practical shape by Watts, attempts to utilize it for water transport were almost immediate. Even before any mill was run by steam the problem of steamboat operation was well on its way to solution, as is shown by the earlier American and English projects around 1785. But it took thirty years to produce a commercial success in this line, and Fulton's *Clermont* was the first vessel to make a real voyage under steam. In the next fifteen years the Channel, the Mississippi and the Atlantic all had steam navigation. Commodities could now be handled cheaply enough by water, provided that there were only some means for getting them to the ports.

The new problem was therefore one of land transport, and at first took a form to which it did not return for over a hundred years. This was motor truck transport, by steam on ordinary roads. The next stage attempted was the laying of rails on roads. Neither of these primitive efforts got very far, as can be readily understood now, in view of the difficulties found later even when we had a lighter motive power. So, at a considerably later date, came a new series of attempts at land transportation, involving two new features. These were the use of a specially prepared roadway or track, and the use of a separate motor power, or locomotive. Stephenson's name is indissolubly connected with the success in both directions, and with the final opening of commercial railroad transportation in 1825. During the sixty years which followed, one of the principal features of periods of industrial activity was the rapid ex-

tension of railroads all over the globe. The maximum of this activity seems to have passed; whatever we may do in future years can never represent the same percentage of advance as has been seen during various periods in the past. Our future progress will take other lines.

By 1860 the great producing regions and markets of the world were pretty well connected by roads, canals, railroads and steamships; and the cost of transporting foods and commodities had fallen to perhaps, on the average, two cents a ton-mile by rail and a half-cent per ton-mile by steamer. This was indeed a very far cry from the fifty cents per ton-mile of a century previous. The effect of lower freights was not only to reduce the cost of commodities in distant markets, but to make possible the return carriage of food supplies to manufacturing countries and centers. For as manufactures increased, there was a relative decrease in farm labor, near the points at which industry was concentrated, and industrial progress would have been brought to an end by lack of local food supplies if more extensive transport of food had not become possible.

In later decades came still greater expansion of the railway web across the continent, along with added facilities for marine transport through the execution of several great canals. And, along with improvements in transport came improvements of almost equal importance in communication, of which the electric telegraph and the cable were the earliest and greatest in effect. Of the more recent improvements in both transport and communication — the submarine and airplane, the gas engine and steam turbine, the wireless — there is little need to do more than note their occurrence. Here also, as in the case of power, the greatest achievements in the way of reducing costs were made in the earlier decades of the new industrialism, and our later inventions have rather been along the line of overcoming special difficulties, as for example aerial navigation, than along the line of greater economy in transport. Whatever

may be the future of air and under-water transport, it can never, because of purely physical conditions, be carried out as economically as transport on water or on land. For any further lessening of commodity prices or food costs we must still look to improvements, relatively slight perhaps, along the older lines.

Food supplies and housing. In the days before the new industrialism, food supplies were local, they were usually scanty, and they were often very uncertain — all of which facts are closely connected. If a country or region grows all its own food supplies, it is practically dependent on local crop conditions. Lacking cold storage, it is limited, for much of its food supply, to the product of a single year. This means that one year of local crop failure causes dangerous shortage, and that a succession of such years means widespread famine. This was the experience of many parts of Europe during many centuries, and it is one of the natural dangers from which we have been delivered by modern industrialism. Improvements in transport have opened up now and cheaper sources of food supply; improvements in farming implements and fertilizers have reduced the cost and increased the output per acre; and both together have very greatly decreased the danger of serious scarcity at any place.

Of these factors improved transportation came to the aid of humanity most promptly, for as soon as steam navigation was adopted the possibility of carrying American wheat to Europe quickly did away with much of the danger of local shortages, and later the Argentine and Australia were enabled to become food suppliers on a large scale, thanks to the extension of cheap rail and water transport. We are just emerging from the most serious test to which modern methods of food supply have ever been subjected, and on the whole they have functioned very well indeed. At a time when half the white men of Europe were engaged in a long war, there has been scarcity of food but not famine.

In later years came improved farming machinery, and at about the same time the commencement of scientific use of fertilizers. Later still we had the beginnings of cold storage, and of the transportation of meat and other foods in artificially refrigerated cars and ships. Still later there was the commencement of a still growing industry — the tinned provision trade.

Next in importance to the question of food supply comes that of housing, and here the new industrialism has met with new requirements and has offered new solutions, both as regards buildings for habitation and buildings for work. The modern world has to deal with vastly increased populations, which are largely concentrated in and near great working and business centers. Both for housing these populations, and for providing working space in factories, mills, shops and offices the requirements are not only larger but more difficult than they were for the smaller communities of earlier periods.

In older days the buildings, of whatever nature, were built of timber, stone or brick; and there was an ample supply of all three of these materials for the small amount of building construction carried on. Further, there was practically no need to build anything to carry weight, for in the rare instances where heavy supplies were stored or heavy implements used, there was ample ground space to put all such matters on a solid ground floor. Finally, since the poulation did not do much work indoors, the lighting requirements were very simple.

For a modern community all of these things are changed, and new materials and methods have had to be applied to the problem. Wood is being largely set aside, except for ornamental purposes, because it is becoming increasingly scarce, it is not strong enough or durable enough, and it is inflammable. On the other hand cement and steel, either used separately or combined as reinforced concrete, fill all the requirements, and enable buildings to be constructed at

low cost, strong, high, well-lighted, and fireproof. Both of the materials we now employ are products of the new industrialism. Portland cement has been used for building construction since its invention in 1824, and iron and steel have been used structurally for many decades, though the so-called skyscraper type of steel building does not go back beyond the decade 1880-1890.

Clothing and textiles. Next in importance to the question of food supply and housing comes that of clothing, though perhaps for certain elements of our population these relative ranks should be reversed. From our present standpoint, however, the order here accepted is logical enough, for the average European and American in 1770 was better clothed than he was fed or housed, by comparison with our modern standards. The gains made during the past century or so in this line have been along the lines of heavy increases in the world's output of textiles, with accompanying great decreases in cost of the fabrics. Both of these gains are due entirely to the adoption of machinery for textile manufacture, and were made in opposition to a natural tendency toward increased prices for the raw materials from which the fabrics are made. That this tendency toward increased prices of raw cotton, silk, wool and flax has not resulted in very sharp price increases for these raw materials has been due to the increased area rendered available for their production through the new methods of transport.

The cotton plant, for example, was introduced into the United States from India late in the eighteenth century, and soon became an important staple in its adopted country. The blockade during our Civil War aided materially in giving cotton raising a foothold in Egypt, while during the past decade it had been established in the Congo and in Brazil. The same thing has taken place with regard to wool, which has added the United States, Australia and

Argentina successively to its original European sources of supply.

The chief inventions which remodeled the methods of manufacturing textiles were grouped in the forty years following 1760, so that by 1804 modern types of machinery were in operation, in England, France and Germany, in a number of plants. Steam power had been introduced for cotton mill operation as early as 1785, and spread quite rapidly in the English textile centers. From the beginning of the nineteenth century onward the progress was steady and rapid in all the industrial countries.

Some rough idea of the amount of the changes thus brought about in clothing materials may be gained by noting that the world's production of cotton has increased about twenty times in the past century, from around one million bales in 1810 to around twenty million bales in the years immediately preceding the World War. This increase, though far less than that shown by iron and coal during the same period, is still very large as compared with the increase in population. We might figure that in 1800 the cotton output amounted to less than one pound yearly per capita of the world's inhabitants, while a century or so later it had risen to some six pounds per capita.

Prior to 1800, and indeed down to the middle of the nineteenth century, wool and cotton were approximately equal in supply, but from that time on cotton output increased heavily while wool showed little advance, so that now the total wool clip of the world amounts to only about one-fifth the weight of the cotton crop. As regards population, this implies that the average inhabitant of the world, supplied with about one pound per year of wool in 1800, has now about one pound and a quarter. In other words the world's wool production has not much more than kept pace with the growth of population, and in

future is likely to fall behind rather than improve. That is of course the case with animal foodstuffs also, for though modern methods can keep down the price of animal products, they have no appreciable effect on increasing their total supply. We encounter much the same difficulty in regard to vegetable products, though not to the same extent, for here improved methods of cultivation do have some effect, though less than generally thought, on the average yield per acre.

Iron and the metal industries. In passing from foods and fiber supplies to iron and steel we have passed from a field which is not entirely under mechanical control into one in which our output is, as yet, limited only by the demand for the product, and not by natural difficulties in the way of securing heavily increased supplies of raw materials.

This facility in enlargement of production is shown strikingly when we consider the growth which the iron industry has shown since modern industrialism commenced. We may perhaps estimate the iron output of the entire world, in 1750, at certainly not over two hundred thousand tons, and probably far less. By 1800 this had increased to some eight hundred thousand, and by 1850 to almost five million tons. The end of the nineteenth century saw an annual iron output of over forty million tons, which was increased to almost eighty million tons in the year before the war.

This implies that the average inhabitant of the world was supplied with about two pounds of iron per year in 1800, as against an average now of almost one hundred pounds. The iron output increased fifty times in that period, during which as we have noted the cotton output increased twenty times, and the wool output five times. These comparative figures serve to give some idea of the relative facility of meeting increased demands for mineral, vegetable and animal products, and of the relative advances which the

world has been able to make along these three lines during a century of mechanical progress.

There is one matter, however, which must be brought to attention, in order that we may have a proper background against which to see and understand the very wonderful changes which were brought about. The point to be noted relates to the price, actual and relative, of iron at various times. We are accustomed to thinking of iron as being by far the cheapest of the metals, so cheap that no limitation on its reasonable use can be set by questions of price. Both these things are true to-day, but they are not always true; and it is due entirely to relatively modern industrial development that this change has come about. In the happy days of our forefathers iron was not the cheapest metal, and it was entirely too dear to use for ordinary purposes. The fact that we can now use it freely for ships and rails and buildings is generally accepted as implying that this was always the case. Nothing could be farther from the truth; for until the world turned its attention to quantity production by means of the despised "factory system" iron was a good deal of a luxury.

Actual price comparisons at various dates will serve to show that these statements, though probably novel to most, are not unfounded. Thanks to the researches of Thorold Rogers, it is possible to make comparisons for several of the earlier periods, and there are of course ample records for conditions after 1750. Fortunately we have available data as to another metal — lead — convenient for study of relative prices, for lead has always had wide-spread industrial uses and for a long time its sources of ore supply and methods of metallurgy were practically unchanged. Prices have in all cases been converted to current price equivalents and expressed in dollars per ton.

About the year 1350, just prior to one great renewal of commercial and scientific activity, iron sold in England at what would now be equivalent to about $2500 per ton. In

the latter part of the seventeenth century, after considerable industrial improvement had occurred, wrought iron still sold at a price comparable to $360 per ton, while lead was worth just about half as much, $160 per ton. By the middle of the eighteenth century, before the new industrialism had shown its effects, the two metals had reached substantial equality, at about $80 per ton. Before 1810, $25 per ton for pig iron and $45 to $60 for either wrought iron or finished castings, were normal prices in England and America. With the foregoing we may profitably compare such prices as $10 per ton for pig iron, $22 per ton for bar iron, and $18.75 for steel rails, made at Pittsburgh in the low record price year 1897. We may fairly summarize the matter by saying that in our last period of very low prices, iron sold at one quarter of the price it commanded in the depression of 1740; and at less than one per cent. of its fourteenth century price.

The fact that the world's iron output has increased so largely, concurrently with a large decrease in the price of iron per ton, is only to be explained when we consider the great improvements which have been introduced in iron metallurgy during the period which saw this growth in output and reduction in cost. The leading changes are tabulated on a later page (p. 313), which serves to give an idea of the technical progress made, in point of time, as compared to the developments in other lines of industry.

The chemical industries. In passing to the chemical industries, we face the chief industrial problems of the future, for great as has been their past development this group seems likely to show still more striking results in the years to come. With regard to coal and iron, we know now about what we may expect in the way of supplies, and costs and uses; with regard to the chemical products, we are in many lines only commencing to study them.

So far as the heavy chemicals are concerned — the chief inorganic acids, alkalis and salts — their history and de-

velopment run almost parallel with that of iron and steel, for most of them have been made on a large scale for well over a century. New supplies of raw materials have been developed, and there have been great changes in methods of manufacture, along with large increases in output, for such products as sulphuric acid, soda, alums, explosives and fertilizers. For all of these groups sulphuric acid is a basic semi-finished product, and a very fair idea of the progress of the heavy chemical industry of the United States can be gained if we compare the figures as to domestic output of sulphuric acid over a series of years. This is done in the table below.

Year	*Output, short tons*	*Per cent. increase annually*
1870.....	50,000	..
1880.....	154,000	12
1890.....	693,000	18
1899.....	1,353,000	9
1904.....	1,642,000	4
1909.....	2,401,000	8
1914.....	3,162,000	6

From this it will be seen that the American industry, after a very rapid growth in the early decades, has now steadied down to a rate of increase not very far above that shown by the coal and iron output of the United States.

But with regard to the organic chemical products, particularly these derived from coal and petroleum, the case is very different, and it seems likely that here we are to look for the great progress of the future decades. In these groups we have whole hosts of useful products entirely unknown to the world prior to the last century, and many of them not produced until very late in that century. Such products, and others along the same general lines, may display surprising increases of output and utilization in future. And in their discovery and manufacture, more than in any other line of industry, we have learned to

Power Developments	Transport and Communication	Food Supply and Housing
	1761. First English canal	
	1765. English macadam roads	
1769. Watts steam engine		
	1779. First iron bridge	
1781. Compound steam engine		
1785. Engines in cotton mill		
Steam pumps adopted in coal mines		1798. Gas light used in mill
	1807. Steamboat on Hudson	
1815. Miner's safety lamp		1815. Gas light in Paris
	1816. Steamboat crosses Channel	1816. Gas light in Baltimore
	1819. Steamer crosses Atlantic	1817. Gas light in London
		1823. Gas light in New York
	1825. Railway in England	1826. Reaping machine
1827. Water turbine	1825. Erie canal	1826. Portland cement invented
	1829. Railway in U. S.	
1831. Dynamo invented	1831. Iron ships	1833. Mowing machine
		1837. Cotton seed oil
	1836. Screw propeller	1839. Iron buildings
	1840. Penny postage	1840. Liebig fertilizers
	1845. Electric telegraph	
		1850. First fertilizer works
		1858. Kerosene lamp
1867. Dynamo perfected	1861. Transcontinental telegraph	
	1866. Atlantic cable	
1867. Otto gas-engine	1869. Union Pacific railroad	1865. Steam plow
	1869. Suez Canal opened	1867. Artificial ice
	1873. Duplex telegraphy	1870. Refrigerated meats shipped
	1875. Air brake	1876. Roller mill for flour
	1876. Telephone	1876. Electric lighting
		1880. Harvester
1883. High speed oil engine	1880. Trolley car commercialized	1886. Incandescent gas mantle
1884. Steam-turbine		1888. Chrome tanning, leather
	1886. Motor car	
		1895. Acetylene gas
	1896. Wireless telegraphy	
	1898. Trans-Siberian railroad	
	1900. Zeppelin airship	
	1906. Air plane	
	1915. Panama Canal	
	1915. Submarine crosses Atlantic	
	1919. Air plane crosses Atlantic	

Textiles, Etc.	Steel and Machinery	Chemical Industries
	1735. Coke used as furnace fuel	
	1740. Crucible steel invented	1740. Sulphuric acid made
		1746. Lead chamber used
	1760. Improved blast apparatus	
1764. Spinning jenny	1767. First saw mill	
1769. Spinning frame		
1779. Spinning mule	1783. Rolling mill improved	
	1784. Puddling adopted	
1785. Power loom		
1785. First steam cotton mill		
1785. Bleaching by chlorine		
1792. Cotton gin invented	1790. Steam used for blast	
1792. Well-combing machine	1795. Hydraulic press	1803. Paper making machine
1801. Steam power loom		
1804. Jacquard silk loom	1811. Furnace gases used for heating	
1828. Ring-spinning machine	1828. Hot blast used in furnace	
	1830–1840. Machine tools	
1832. First sewing machine	1838. Steam-hammer	
		1839. Vulcanizing rubber
1846. Howe sewing machine	1846. Hydraulic crane	
	1847. Cast-steel guns	1846. Gun-cotton discovered
		1854. Wood pulp paper
	1856. Bessemer steel process	1858. Coal tar dyes
1858. Shoe machinery	1861. Power rock drills	1865. Nitroglycerine
	1864. Open hearth steel process	1866. Dynamite
	1868. Alloy steel (tungsten)	1869. Celluloid
		1875. Contact process for sulphuric acid
	1878. Basic bessemer steel	1880. Synthetic indigo
	1885. Cowles aluminum patents	
1889. Mercerized cotton	1889. Hall aluminum patents	
	1895. Use of furnace gases in gas-engine	1893. Electrolytic soda

depend, not on happy accidents or empirical rules, but upon scientific research and careful technical control.

The comparative progress of invention. At the outset of this discussion it was suggested that usual long lists of dates and inventors might well be dispensed with, as not throwing much light on the subjects in which we were most interested. That is true enough, and that rule has been followed religiously so far. But at this stage of the discussion, having outlined the progress made in different lines of activity, and having noted the broader effects of the various changes in process or in material, it will be of interest to summarize the matter in somewhat graphic form. To this end the advances made in various lines are arranged chronologically in the table which follows, each group of activities being placed in a different column. By this means we get a fairly complete view of the general relations borne by matters which are too often considered as entirely separate phenomena.

The incitement to invention. Too much stress is commonly laid upon the relation of race or nationality to relative progress in discovery and invention. At times this takes very crude forms of expression, and in its manifestations during the recent war there were some very remarkable examples of absurdity along this line. But even when individual race pride is not so blatant, one often meets statements, for example, that English and American inventive genius lies along the line of mechanical improvements, while German and French genius trends toward chemical and purely scientific progress. In reality there is a fact concealed under even this mis-statement. It is not true that any remarkable racial genius has led to these results, but it is true that for a century or so the other conditions of these countries have led in these directions.

The factors necessary to bring about invention are not single, but numerous; they have little relation to race or nationality *per se*, but very close relation to the industrial

conditions which happen to obtain in a given nation at a given time. For inventions and discoveries do not arise sporadically, but are to a very large degree forced or incited by the environment. We may justifiably divide technical progress into two types of advance, not very closely related, which bring about two different kinds of invention and tend to develop two different types of inventor. First, we have the case where there is some well-known commercial necessity for an improvement in an existing process or machine or product. This is apt to be met by an invention proceeding from someone actively engaged in that industry, whether as employer or as laborer; but it also may proceed from an outsider who has his attention called to the necessity. The invention of the steam engine and the cotton gin are of this latter type, for neither Watts nor Whitney were engaged previously in those industries. Second, we have the class which is of increasing importance, where an invention proceeds from a scientific advance of some sort, and in this case the inventor is apt to be a scientist, so that both discovery and invention come from the laboratory, rather than from the mill.

In either case a period characterized by great inventive progress implies that there is wide activity locally in the industry; that the conditions to be met are pretty generally known, and that there is a high average level of technical knowledge and education in the country or region. It is because of these necessary conditions that we have such phenomena as whole decades during which the United States will turn out invention after invention along electrical lines; or others during which Germany makes improvement after improvement in chemical processes and products. It is not that an American is a born electrician, or a German a born chemist; it is merely that during certain periods all the industrial tendencies in those nations centered about certain lines of industry.

The relation of a patent system to invention is not so

clear as is usually thought. For example, the French have an atrociously bad patent system, while the German was perhaps the best anywhere. But it would be difficult to prove that, prior to 1871, German scientific discoveries or German mechanical inventions were equal in number or importance to those of the French. The two nations are compared simply because they are adjacent, have had about equal populations, and had for a long time about equal economic development.

For the same reasons we may fairly compare Great Britain and the United States, on the same bases. The first cost of a British patent is very high, so high as to distinctly limit issues; it offers a fair guarantee as to the novelty of the invention; and good protection afterward. On the other hand the cost of an American patent is very low indeed; it gives a very good assurance as to novelty; and a lower degree of protection. The American system is an obvious incitement to application for patent, and it has had this effect so far as mere numbers are concerned. But even an ultra-patriotic American might hesitate to pronounce as to other results. To limit attention to the most important of our industries, what have we done that ranks in its effects on iron and steel manufacture along with the inventions of puddling, the hot blast, the Bessemer process, the Thomas-Gilchrist?

A matter which has a direct bearing upon two different political questions — the advisability of monopoly and the possibility of socialism — is the extent to which the existence of competitive conditions incites invention. It is often assumed that inventions arrive as if by an act of God, and that they would in any case appear at certain times regardless of commercial conditions. Nothing could be further from the truth than this idea, for as a matter of fact practically every new method or process is invented as the direct result of free competition, and every new method that is adopted is so adopted because competition exists.

In the absence of competition there would be no incentive to work out a new process, and every incentive not to apply it if it happened to be invented. For in every case a new process means writing off a part of your fixed capital, and scrapping existing plant. If you have no competition there is no reason why you should accept this certain loss.

Now, under monopoly control of an industry, so long as we still have individual ownership of that monopoly, there is still some reason to adopt a new invention, even in the absence of competition, if it means that by its adoption the loss due to scrapping the old plant can be quickly made up, and that later operation will show an increased percentage of profit on all the capital involved. The incentive to make such economies will not be as great as if a competitor were in the field, but there will still be some small incentive. And what we actually see is that in industries which have arrived, in some country, close to the monopoly stage, there is still some advance in practice, though not as much as when competition is bitter.

But under socialism, even the slight incentive felt by private monopoly is done away with; for there is no way in which the loss on the old plant can be made up. It surely can not be done by increased profits, at the expense of your fellow socialists engaged in other trades. So far as I can see, the existence of private monopoly is a severe blow to any future advances in industrial methods, but the adoption of government ownership or collectivism would stop such advances entirely.

The question of patent monopoly, however, involves certain difficulties in its bearings upon two different phases of the question of progress. Giving a monopoly to an inventor, by means of a patent, seems to be an almost necessary condition to technical progress, for we have found by long experience that a process or product not covered by a patent is not taken up very rapidly by industry. On the other hand it is almost equally disadvantageous to technical

progress to have an industry monopolized through patent control, for there is too little incentive to carry out any further advances, once effective control is established through ownership of basal patents.

CHAPTER XVII

THE RISE AND FALL OF PRICES

At intervals, during preceding chapters, reference has been made to the fact that prices of manufactured commodities, though fluctuating widely from year to year, have on the whole shown great decreases from levels known prior to the adoption of machine industrialism. Heretofore no discussion of these phenomena has been attempted, but now we can pay some attention to the facts regarding price changes and to the causes which seem to underly them.

There are two features regarding prices which are of industrial interest. First of all, we may assume for the moment that no changes in currency or credit conditions occur, so that the general price level remains constant, and on that assumption go on to consider what changes have occurred or are likely to occur in the prices of individual commodities, as the result of technical or other changes. Second, abandoning the individual commodity, we may consider to what extent there have been changes in the general or average price level.

I. Changes in Individual Prices

The increase in demand. It is needless to say that the price of a commodity at any given time is a rough effort to balance the existing supply and the effective demand for that particular commodity. To express this fact in a formula is simple enough and frequently done, but it does not add to our information in any way. The matter of real interest is to determine the factors which influence the demand and the supply, so that we can come to some conclusion as to the direction in which prices are tending. This can

be done for broad groups of commodities in a fairly exact way.

We saw in an earlier chapter that the demand for commodities increases in at least the same ratio as does the population, otherwise there would be retrogression in living standards instead of progress. For foodstuffs, clothing and housing the demand would not increase much faster than population, if it were not for the fact that great fractions of the earth's population are still deficient in these three things. So that even for the things of which we do not use more, individually, than did our grandfathers there is a demand for a greatly increased annual supply.

Further than this, the spread of wealth and education have raised the general idea as to what constitutes a reasonable and comfortable standard of living, so that there is an increased demand for many articles of personal adornment or use, as well as for articles which add to the comfort of the home and the community. None of us would be satisfied to return to the very limited life of 1800, and all this implies again a large increase in demand per capita for another great group of commodities.

Of the two factors which have so far been mentioned, the first will act until all the world attains a reasonable amount of food, clothing, sanitation and housing. This promises many years of increasing demand from this source, but it is not entirely indefinite in its completion. There will come a day, within the present century in all likelihood, when this requirement will be fulfilled, after which the demand will fall to the rate at which population increases. The second factor — higher living standard — is less easy to value correctly; it would increase without end perhaps if wealth kept pace with it; but it is likely to fall off severely during a long period of depression, and for this reason the commodities affected by it are not so stable as those very necessary things which are affected by the first factor.

But aside from the things so far considered, we must

recognize that a very large proportion of the commodities we make are intended, not for direct use and consumption, but for the transport of other commodities or as implements in making other commodities. All of our ships, locomotives, cars, machine tools, etc., fall in this class. It is the group for which demand has been most insistent during the past century, but it is also the group which will first indicate a falling off in the rate of industrial development, for these things are all of semi-permanent character, and are the things with which the world can most easily become overstocked, temporarily or permanently.

From this brief outline we can see that the character of a commodity has a good deal to do with the rate at which demand for it has increased during the past years. We can now turn to the question of supply, and see how various classes of commodities are situated with regard to the possibility of meeting largely increased demand.

The possibility of increased supply. We can see, on very slight examination, that different kinds of commodities are in widely different positions with regard to the possibility of responding to a great increase in demand. The supply of some commodities can be increased very quickly, and of others only after long preparation; in some cases the increase in supply has no practical limit, in others it means increased cost, in still others little increase is possible at any cost.

We may say, though there are individual exceptions, that certain broad groups of commodities have the following properties in these respects;

Animal products — meats, hides, fats, etc.— can be increased to some extent as demand increases, but only very slowly, and to a very limited ultimate extent.

Vegetable products can be increased, not immediately but more rapidly than animal, and to the extent that is limited by the land that can be taken into cultivation.

Mineral products, so far as they are already being mined,

can be increased quite rapidly in response to increased demand, up to the point that actual scarcity of the mineral begins to show itself. But when that point is once reached, since no human effort can increase the total supply of coal, oil, ore, etc., a mineral product will show no response even to a very pressing demand.

Manufactured products, being made by the combined use of raw materials, labor and machinery, offer a more complex problem. In general they can respond very quickly to increased demand, since normally there is a surplus of power and mechanism. Furthermore, if the increased demand is steady and likely to be continued for some time, there will be the construction of new mills and factories to meet it. On the purely mechanical side there is no apparent limit to increased production of manufactured commodities. But in so far as they use animal, vegetable or mineral raw materials, manufactured commodities are subject to the limitations of those groups, and the ultimate supply is limited by the quantity of raw material that can be furnished.

Effects on prices. We may now apply the conclusions as to the demand and supply conditions existing in these great groups of commodities to the question of changes in price in these groups. It will be seen that, other things being equal, animal products are likely to rise in price as the world grows more densely populated, especially since raising animals is a relatively dear way of using land of any sort. The only things which tend to hold down the prices of animal products are great improvements in transportation and treatment. During the past century the world has seen several important changes in both these respects, and it seems safe to say that if it were not for the steamships, the railroad and artificial refrigeration the prices of meat and leathers might easily be several times as high as they are even now.

Vegetable products, both foods and fibers, are more sub-

ject to human control, and with the help of transportation improvements are less affected by increased demand, up to the point of land scarcity. Their prices would tend to increase as poorer or more distant land is forced into cultivation, but so far the improvements in transportation and in farming methods have aided materially to counteract this increase.

The case as regards mineral products has been discussed in detail in Part II of this volume, and here we need only refer to it. In these earlier chapters we found that there seems to be reason for the belief that in some of our main products — coal, iron ore and copper ores — we are likely to enter a higher range of prices, as compared with the general price level of other commodities.

With regard to manufactured products it will be seen that no entirely general statement can be made. In the past, increased power and machinery, and improvements in process have been so great that the prices of practically all manufactured commodities are far below what they were a century ago. Even temporary periods of high general prices, such as the one through which we are now passing, do not suffice to carry the price of iron and steel products up to the level of 1800, or even of 1870, while each depression in average commodity prices has so far carried iron and steel products down to new low levels. This condition can not be expected to persist, however, for we will finally reach a point at which growing scarcity of coal and ore will prevent low costs for the finished products, and will consequently prevent new low price levels. That point, in my opinion, was reached two decades ago, and it does not seem possible that the next great period of low average prices will see steel products selling as low as they could in 1897 and 1898. Similar changes are taking place in such other manufacturing lines as are closely dependent on raw material conditions.

II. Changes in the General Price Level

The general course of prices. Heretofore we have been considering the course taken by the price of any single commodity or group of commodities, under varying conditions as to demand and supply. But in addition to such individual variation in prices, there are price movements far more general in their scope and effects — great waves of rising or falling prices which affect all commodities substantially alike. The existence and extent of such more general price changes can only be determined if, instead of paying attention to the prices of a single commodity, we examine the prices shown by a large number of commodities during a long series of years.

This is done in the various "index numbers" or "average prices" which have been devised, on varying bases, by different authorities, and which have been extended in some cases to cover the range of general prices for a century or more. Figure 7, on page 231, shows one of these series of price records, placed in graphic form, covering the period 1800 to 1920. The figures here used as a basis from 1800 to 1910 are those of Jevons and Sauerbeck, as recalculated by Layton so as to give a continuous series for the years covered. This series is longer than any available American index, and it gives a better idea of world price conditions, being free from the possible criticism that our own prices have been influenced by tariff legislation or fiscal policies. In this connection it might be noted, however, that comparison of British, American and German price averages over long series of years show in reality far less differences than might reasonably have been expected. For the years 1911 to 1919 inclusive I have joined on the Dun index number, lowered slightly so as to correspond to the other series, for the sake of showing our present price position relative to the levels of previous periods. It will be seen later that some light is thrown on our existing world-wide

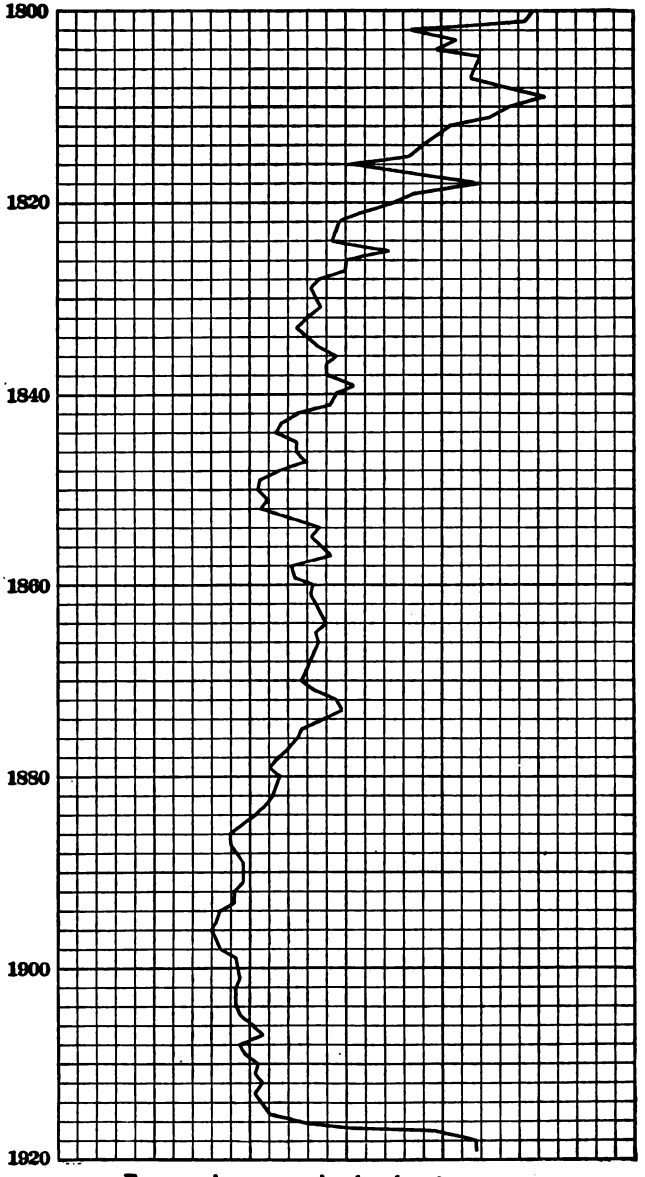

FIG. 7. Average price levels, 1800–1920

labor unrest by this comparison, and it is also of interest as giving some idea of the normal progress and ending of a war inflation.

The diagram on page 231 brings out the price situation very sharply indeed. Looked at in its broadest form, it is that during the Napoleonic wars commodity prices rose to a level from which they fell, sharply at first and more slowly thereafter, for thirty-five years. Then, around 1850, there was a secondary rise in average prices, which did not last long, and which did not begin to approach the high levels around 1800 to 1810. This secondary rise, due in part at least to the California and Australian gold discoveries was in turn succeeded by a new fall in prices, carrying averages to low levels never before known, and culminating around 1896 to 1898. From this again there was a trifling price rise, which gave every sign of being near its end when the World War suddenly gave it new life. The history since 1914 is familiar to us all. Prices have risen almost to the level reached during the Napoleonic Wars. What we have to bear in mind is that as after these wars, they will fall again with equal fatality and completeness. The real difficulty ahead of us is not the continuance of the present high price level, but the characteristic troubles which inevitably come as prices plunge downward over a long series of years.

Booms and depressions. There are two matters of interest in connection with the price changes shown on the preceding diagram. One of these is the interrupted or rhythmic form taken by the price curve, for it will be seen that each of the long swings is in reality made up of a series of smaller wave-like forms. Prices did not move continuously downward from 1810 to 1850, for example, though their general trend through those forty years was downward. But this general trend was interrupted at intervals by smaller upward moves, followed again by renewed falls in prices. Each of these rises represented a temporary

boom in business; and on the other hand ended in a financial crisis or depression. When the crisis was very sharp and acute, so as to result in a financial panic, it is apt to be borne in mind longer than when the result is merely a long sagging depression. For this reason the literature of finance will give full details as to at least the later crises — those of 1819, 1837, 1857, 1873, 1884, 1893 and 1907, all of which are located at or near the peak of a rise in prices, and at the beginning of a more or less long and serious downward swing in the price curve. The matter is of particular interest to us now, because we seem to have reached a very remarkable peak in prices in 1920, and we may expect the natural consequences.

In popular opinion, a war is a time of active trade, while a financial crisis brings on liquidation and a period of business depression. It may therefore seem unorthodox to say that a war is economically an utterly bad thing, while a financial depression is not entirely evil, though very unpleasant. A crisis followed by a period of low prices, however painful it may be at the moment, is a period in which industries are being conducted economically and efficiently. A financial crisis is the natural remedy for over-expansion, for wasteful practices, and for personal, industrial and governmental extravagance. Unlike a war period, a time of low prices is marked by fertility in invention, and by the careful and economical operation of industry and business. Economies in old processes, and experiments with new processes, are alike taken up most seriously when the margin of profit is low and not when it is high.

Causes of crises. Something might be said, in passing, as to the causes of these periodic alternations of depression and prosperity, and especially of the causes of financial crises, because there are still too many currently expressed opinions which are based on limited observation or vitiated by personal and political bias. It is hardly necessary to recall, as instances, that popular agitators have ascribed

financial crises of world-wide extent as being due to the evil machinations of a few men in Wall Street; that politicians of a little higher intelligence have credited depression and prosperity to changes in the ruling party, to tariff modifications, or to legal enactments of one sort or another; or that bankers and business men, losing sight of other and more important factors, have at times fallen to the politician's level of thought and placed too much stress on purely political or legal factors, or on essentially local conditions as to the currency. These misconceptions would be of little importance if it were not for the fact that they all tend to accustom their acceptor to seek for a definite and immediate remedy for conditions which are in reality too general to yield to such treatment. It is doubtless convenient to look toward some given man, toward some particular law, or toward some definite administrative action — and to really expect that the man, or the law, or the government policy will be able to make a complete change in financial and industrial conditions. It may be convenient, but it is merely a survival of the barbaric superstition which expected aid and protection from a mass of wood or clay, provided it were approached in a hopeful and believing spirit.

As a matter of fact, study of industrial history gives us little reason to hope that financial crises and industrial depressions will become less frequent or less serious in the future than they have been in the past. In order that they might be completely avoided it would be necessary to assume that men's thoughts and feelings will become mechanically judicial; that harvests will never disappoint; that wars and natural disaster will cease to occur, and that each laborer and each capitalist will be satisfied with his present condition in life. Until these changes in general conditions are brought about, we may fairly expect to see periods of over-enthusiasm followed by periods of over-depression.

The effect of periods of depression upon the technical

features of an industry — economies and improvements in practice — has been noted in a preceding paragraph. It may now be suggested that the alternation of prosperous and depressed periods has certain relations to the more general features of the industry — and that it affects, to a certain extent, the general tendencies which all businesses show toward expansion geographically, toward integration and toward combination. The existence of these general tendencies, and the manner in which they manifest themselves in the larger manufacturing industries must be discussed elsewhere. Here we are only concerned with the extent to which they are related to the periodic fluctuations in business conditions.

In discussing elsewhere the tendencies of industrial growth, it is stated that all industries tend to develop along four different, though related, lines. These developments are toward (1) increasing the size of the individual mill, or manufacturing unit; (2) expanding geographically, so as to secure new markets; (3) acquiring control of earlier or later stages of the manufacturing process (integration); and (4) combination, of one sort or another, to secure market control.

Of these four lines of development, the first three cost immediate outlays, and promise no immediate returns. It is consequently difficult to convince a manufacturer, during a period of trade depression, that he must increase the size of his mill, that he should buy or build new mills elsewhere, or that he should purchase the mines which furnish his raw materials, or the fabricating plants which finally market them. On the other hand, when business is highly prosperous, it is easy to believe that such developments are advisable, and to finance them. So that ordinarily we find industrial companies extending their operations in one or all of these lines, not during periods of depression, but during periods of prosperity; and frequently near the close of such prosperous periods. Such developments are, in fact,

merely instances of the general tendency toward over-expansion which necessarily brings periods of prosperity to a close.

With regard to combinations of any type the case is somewhat different. In so far as these combinations are natural, they are more likely to come about during periods of intense trade depression than while business is good. It is only when prices of the product are low that manufacturers are willing to consider entering into combinations which must necessarily restrict their individual freedom; and it is only when profits are vanishing that they will have reasonable ideas as to the value of the plants. For these reasons we find that most of the pools, agreements and combinations have, in all countries, been formed during periods of business depression. To this general statement there is an important class of exceptions. These relate to combinations formed primarily in order to supply underwriting profits to promoters and bankers. Obviously combinations of this sort can be put through with the least risk during the early stages of a prosperous period, when confidence is returning and money is still free; and as in this case the price at which the individual plants are taken over make little difference to the promoter, there are no counterbalancing objections.

The course of prices. The minor changes in prices which we see every five or ten years coinciding with our booms and depressions, are caused directly by the state of banking credits and business confidence or distrust. But there have been, in the world's history, price changes of more lasting effects; and these have been caused variously by wholesale debasement of the currency, by paper-money inflation and government expenditures, and twice at least by actual over-addition of gold and silver to world currencies.

There is no need here to go back over the earlier experiences in these lines. We can commence with the known

fact that during the early part of the eighteenth century there was a sagging price range and commercial depression, due in part to the reaction after the long wars of Louis XIV. The wars of the middle of that century produced

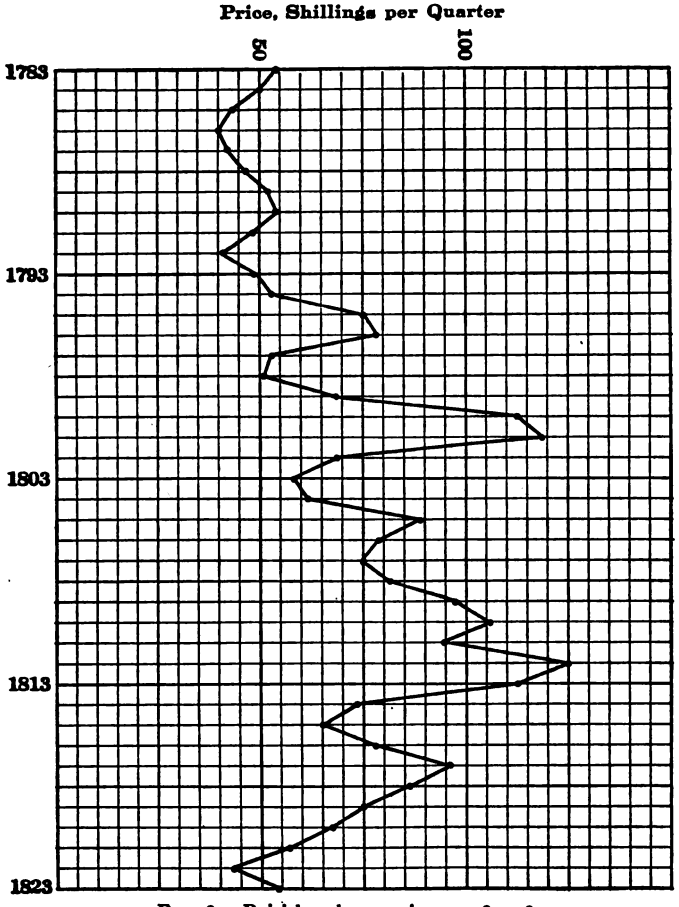

FIG. 8. British wheat prices, 1783–1823

their usual effects — extravagance and temporary higher prices — but no lasting change. At the commencement of the twenty-five years war between Great Britain and the French republic and empire, the average price level was

about the same that was afterward reached around 1840 and again around 1890 to 1900. If we keep this fact as to the price level preceding the Napoleonic Wars firmly in mind, it will go far toward clearing up later results.

As soon as Great Britain entered on her long struggle with France the price level began to rise, not because of any addition of gold or silver to the currency of the world, but simply because all governments began buying supplies freely and paying in all sorts of excuses for real money. The effects on prices were worse in France and England, where the currency inflation began earliest and reached its worst excesses, but they gradually spread all over the world, as the neutral nations sold in these inflated markets. The accompanying diagram, figure 8, will serve to show the effect on the current prices of British wheat, sold in its home market, during the years 1783 to 1823 inclusive. This period has been selected because it shows the low levels before the war, the war inflation and the sharp fall following the peace.

Wheat has been selected as being the only broad market commodity of whose fluctuations we have steady records, but all other goods showed similar effects. The rise in prices for a number of raw or manufactured commodities is given in the table below:

NAPOLEONIC WAR EFFECTS ON PRICES

	1780–1785	*1805–1815*
Wheat, per quarter.....	40 shillings	126 shillings
Lead, per ton.....	350 "	625 "
Spanish wool, per pound.....	78 cents	$1.80
Pig iron, per ton.....	70 shillings	180 shillings
Copper, per hundredweight.....	80 "	143 "

These figures might be extended indefinitely, but it will be simpler to summarize the matter by saying that between 1783 and 1813 prices of all commonly used goods rose from 150 to 200 per cent.; on the average prices were 2½

times as high during the last days of the war as they had been before it. This is of interest now, because we have seen almost, though not quite as great a rise produced recently by the World War. And this earlier case is of importance because then there was no complication introduced by a large new gold supply. We can credit all the price rise during the period 1785 to 1815 to government purchases and financing. In considering price conditions to-day, it will be well to realize that this is no new thing which has befallen us, but that precisely the same phenomena, in somewhat greater degree, appeared during the previous great world war.

The financial and commercial sequel to the Napoleonic adventure should also be of interest, since it points out the course which our present prices will follow. The Allied successes in 1813 made the end of the wars seem near, and there was a purely anticipatory break in prices in 1813 which continued after peace was declared finally. In 1815 England, preparing to dump goods in the markets of the world, which it was assumed were bare of necessities, found that there was really no pressing demand for commodities. There had been local manufacture everywhere, even in America, and in the war-ridden countries of Europe. So goods were thrown away, literally — ships lay in New York harbor whose cargoes could not be sold for enough to pay for unloading. Prices broke with violence in all lines, and a financial crisis supervened, so that the period 1815 to 1819 was our first world-wide time of financial and commercial stress. By a series of jerky descents prices finally fell, by 1845 or thereabout, to about their pre-war level, the bulk of the fall being accomplished in the years immediately following the war. If we accept 100 as the average price level of 1785, we might say that prices reached over 250 by 1810; but that within a year after Waterloo they had dropped to 125, and by 1845 to their original 100.

The period between 1815 and 1845 was not, as will be

seen by referring to figure 6, a steady descent in prices. It was marked by a series of booms and collapses; the former caused successively by land speculations and later railroad construction in the United States and South America, as well as in Europe. The collapses came, in each case, when much of the world's capital had been locked up in enterprises which were either utterly useless or remotely productive, a condition which had to be corrected by financial crises and later commodity price recessions.

Around 1850, however, there was a new feature in the matter, for the price level rose about fifteen per cent. above its current range, and remained fluctuating about the new range for twenty years. This rise seems to be due to the gold discoveries in California (1848) and Australia (1851); in part to the actual gold which entered the world's currency systems, but in larger part probably to the incitement to business activity caused by the mere fact of gold discoveries and the rush to colonize.

The gold discoveries, the American Civil War and the Franco-Prussian War kept up the price level until after 1873, when a world-wide crisis paid for the previous overexpansion. After this crisis average prices fell, with hardly any recovery, to a low point in 1896-1898, a level lower than had ever been known before, even lower than that of the pre-Napoleonic period. From this low level renewed government losses in the series of small wars — the Spanish-American, the South African, the Balkan — caused a smaller rise in average prices; but by 1913 this rise seemed to have culminated. Then came the mad financial debauch of 1914-1918, carrying prices within a few years almost to the high point reached in 1810; and for this we have yet to pay.

It will be seen that in telling the story of price changes from 1785 to 1920 it has not been necessary to invoke protection or free trade as causes of high or low prices; bi-metallism in America does not require note; Lloyd George and

Theodore Roosevelt; income taxes and trust prosecutions — none of these enter into the matter in any serious way. The story as thus told is therefore not a good campaign document, but it is a fairly clear statement of fact. General prices rise as credit and currency expansion takes place; and an unsound credit position is reached after a period during which governments or individuals have spent too much money either in unproductive things, such as wars; or in enterprises which are not immediately productive, such as canals, railroads, etc. When the war ends, or when business over-expansion is shocked into sanity, there is usually a financial crisis, followed by a long period of falling prices.

If these facts were commonly understood and accepted, there would be less of agitation and foolish legislation during periods of extremely high or low prices. But as it is, we are sure to have such unrest and such legislation periodically, because high and low prices affect different sections of the community in very different ways, so that an agitator, whether an anarchist or a banker, can always appeal to class prejudice with absolute certainty of receiving support. It will be of interest to study briefly these differential effects of prices on classes.

Effects of high prices. During periods of high prices persons living on fixed incomes, however derived, or on relatively fixed salaries, suffer because the purchasing power of their income is sharply decreased. Wage-earners do not suffer, in general, because wages will rise as commodity prices advance, and usually to about the same degree. But it is worth noting that in the very last days of a period of high prices there is apt to be labor unrest, expressed in serious strikes or lockouts, because toward the very end of a boom prices are apt to rise, for a time, faster than wages. Further, when the boom is very near its collapsing point, employers are apt to refuse further wage advances, feeling that their own orders are beginning to come in less urgently. Early in the boom, wage advances are given

freely, because they can immediately be passed on to the price of the product; later this is not so easy, and the employer finally resists. So that our worst labor troubles are at the time when industry can afford them best, because the market is already beginning to be spotty.

During periods of high prices we are always deluged with remedies, mostly of the sort which require new legislation or prosecutions. At times the remedy in highest popular favor is dissolving the more successful corporations; at other times it is the elimination of the retailer; at still others, it may be government ownership of railroads, or old-age pensions, or prohibition. We are a versatile people, and have numerous remedies to suggest. The Russian mind is simpler, so that for over a century the standard Russian remedy for high prices was to kill the nearest Jew. As to actual results it is a question as to whether either Russian or American popular remedies have much effect.

Effects of low prices. During periods of low prices the class most likely to be badly affected is the farming group, for agricultural commodities will sell at low prices while the interest on preëxisting mortgages remains the same. Since this class has large voting power, its remedies for low prices are always noted with attention, but fortunately we have heretofore escaped their actual practice. The common type of reform desired is some cheapening of the currency, by issuing paper money, or by the use of silver instead of gold. A less radical reform is the placing of government loans at low interest rates on agricultural land. This of course creates a favored class of borrowers, and is to that extent objectionable to the individualist, but the evil effect is apt to be less than the good consequences in other directions, so long as the land loans are not offered at less than the interest rate actually paid by government itself.

But because the farmers of the country have been the class which in the past has protested most vigorously against

low prices, we must not conclude that they are the only ones who suffer, or that in future they are likely to be the greatest sufferers during a long period of low average prices. The people who lose during low prices are debtors, of any kind or condition, because they have to pay interest or principal on debts contracted when prices and interest rates were currently higher. A corporation, for example, which financed itself during the past five years by means of a bond issue at a six to eight per cent. rate will suffer severely, compared with less burdened competitors, when interest rates and profits fall well below this level. So far as competition is concerned, either domestic or foreign, bond interest is practically an item in production cost, and a steel company which has managed to load itself with a heavy interest charge per ton of product will be in very bad position as compared with a competitor whose interest charges per ton are lighter. Looking at the matter even more broadly, this is one of the ways in which a war reacts unfavorably on the countries or regions which have been most influenced by purely war activities in the way of trade and manufactures.

After the war of 1870, Germany which received a cash indemnity was in far worse economic condition than France, which had lost both war and money. The effect of the indemnity was to raise the German price level, locally, above that of other countries, so that it encouraged imports of foreign goods and discouraged home manufactures. The effect of any war indemnities which may be received now is open to the same possibilities, for unless such indemnities are applied very cautiously by the receiving governments they are likely to do more harm than good. They may operate to prevent the fall in prices which would otherwise be expected, or at least to delay it beyond an early period; but in the long run delaying the fall in prices would not result in decreasing its severity when it did arrive.

CHAPTER XVIII

THE SHARE OF THE WORKER

In attempting to discuss the way in which the new industrialism has affected the laboring classes we meet with the greatest obstacles, arising chiefly from a perfectly natural but very strong bias toward accepting the viewpoint of a particular class, whichever that class may be. The case would be simple enough if we could accept either of the two extremes wholeheartedly, disregarding entirely the other side of the story, but it becomes difficult if we attempt to appraise fairly the results that have been so far attained, and these that seem likely to come about in future.

The conflict between labor and capital, of which we hear so much to-day, is by no means a new thing, for it dates back to the beginning of civilization. There have always been wide differences in social and financial conditions between different classes of all peoples. Modern industrialism has not brought these differences about; it has, on the whole, tended to decrease them; but it has also brought the division into sharper outline, and it has removed our earlier sanctions for accepting it as a necessary permanency. These changes, which have given the conflict its present importance, are due to the facts that, owing to the Machine Civilization, we no longer deal with employers and laborers as individuals, but as organizations. Concurrently with the rise of the industrial corporation, supplanting the individual employer, there has been the rise of the labor union, replacing the individual laborer. And along with this we have become rationalistic in thought, so that we can no longer offer, as an easy solution, any hereditary or divine sanction for the conditions we find. So that now we have,

in place of an unorganized difficulty, which could be explained as an act of God, a more sharply defined difference between two organized bodies, to be dealt with on purely materialistic grounds.

It is this change in organization and in mental attitude which has given the class conflict its present intensity and bitterness, so that in looking at any individual instance we are apt to overlook entirely the vast progress that has already been made, and the very natural ways in which this progress was really accomplished. And we are, above all, very likely indeed to overlook the fact that the bulk of the improvement in labor conditions has been due to technical and scientific advances, and not to legislation or revolution. We do not need to apologize for the Machine Civilization; the steam engine found a very poor and miserable world indeed, and it has gradually made that world better, in a material way at least. More than this it can not do, but it will continue to do this faithfully if foolish laborers — and foolish capitalists — do not try to wreck the machinery that has been built up.

Labor conditions. At the outset of the modern period, labor conditions in Europe were at one of the lowest points reached during historic times. The first half of the eighteenth century, with wars and bad harvests, had shown in every direction of trade and industry a falling off from the better conditions that had marked an earlier period, and these conditions naturally reacted most painfully upon the agricultural laborer and on the workman in the few mines and mills then operated. It may be recalled, for example, that even in Scotland the coal miners were serfs, attached to the mine and transferrable with it, until around the time of the American Revolution. Without some such background as this we can not so clearly see the advances that came later. What was described as sheer brutishness in the labor conditions of 1830 would have been passed by without comment, as entirely normal in the labor world of 1770.

Critics of industrial conditions, it may also be noted, tend to fix their attention on England, and particularly on the English textile industries. In so doing they overlook entirely the fact that England was only one part, though a very important part it is true, of a very closely-knit European civilization, and that she could not entirely dissociate her fortunes from those of the world at large. It is true that labor conditions were bad in Great Britain in 1815, and for a decade or more thereafter, but they were far worse elsewhere. The truth of the matter was that for twenty-five years the European world had been wasting, in the mad orgy of the Napoleonic wars, the accumulated wealth of centuries, and it was a very poor Europe indeed which emerged from these wars. If it had not been for the very industrialism which is so bitterly criticized, it might have been centuries before Europe recovered from the war losses. As it was, England had been sheltered through this period, and an undreamed of manufacturing ability had been able to develop there freely, even during the stress of war. And it was this new industrialism which made it possible to replace the physical losses with an unexpected rapidity.

When Great Britain first began to practise modern industrialism, in the shape of large-scale machine production, toward the close of the eighteenth century, the immediate effect on British labor conditions was unqualifiedly good. The machinery was simple, and did not require a long apprenticeship; and it was possible to pay far higher wages per day to a machine laborer than to a hand laborer. The natural result was that there was a large flow of labor into the new industries, and a labor surplus began to accumulate in and near the great manufacturing centers, while there was a relative deficiency in farm labor and in the handicrafts. These secondary effects were natural enough, but their results were bad for labor and bad for the country at large, though this latter phase of the matter escaped attention for a long time. At the moment English politicians

were engaged in suppressing the revolutionary ideas of France, and English philanthropists were interested in the question of negro slavery abroad. No one paid much attentions to the condition of British labor at home, until conditions get so notoriously bad that even Parliament could no longer evade their consideration.

A series of Parliamentary committees developed the facts that labor conditions in some industries — particularly in the textile factories and the coal mines — had become intolerable, and that women and children were being worked under circumstances of revolting brutality. In both cases there were obvious advantages, because in a cotton factory the actual physical strength required, at any given moment, is trifling, and a child is almost as effective as a man in some of the operations. In narrow coal seams, too, boys and girls take up less space than donkeys or dogs, and their cost of upkeep and replacement is less.

It would be pleasant to assume that these conditions were due to a purely local cause — that the British employer is racially more brutal than others, or that a century has removed these possibilities everywhere. Unfortunately neither can be held proven. In Belgium, for example, as late as 1892 there were still some twenty thousand children of both sexes, employed underground in coal mines. And it was in the twentieth century that, visiting a southern cotton mill by chance, I saw children of five and six years old working ten hours a day. In an adjoining state, the same year, there were women and ten-year old boys working in iron mines, rented out to the owners by the State.

Labor conditions can not therefore be left entirely to chance, for even if the vast majority of employers are intelligent, there are in every country a few stupid enough to believe that cheap labor means low costs, and this stupid minority can do a great deal of damage. Experience has shown that with regard to the employment of women and children, and unsanitary or dangerous working conditions,

legislative control is necessary. This of course requires a certain degree of civilization in the country adopting such legislation, but that level has been reached in most of the countries which we consider at all progressive. Such legislation has in most cases been adopted as the direct result of the political pressure employed by organized labor, and it is one of the few clearly beneficial results attained by labor organizations. Every one will agree that their action, in such cases, has been entirely for the good of the community.

The rise of wages. With regard to the next point to be considered — the wages received by the laborer — the case is not so clear as to either the facts or the influence at work. There has been a general rise in wages, looking at the matter very broadly, which has now lasted for over a century, and this general upward trend of wages has persisted even during the long periods when all commodity prices were steadily falling. The result is that not only does the average laborer receive more dollars per year now than in 1800 or 1850, but he received, at least until the beginning of the World War, a far larger purchasing power, as measured by the amount of food or clothing or transportation he could buy with his wages. This is brought out very clearly if we compare the two sets of data for the period 1850-1910 for example, for it will be found that during that long period wages rose on the whole quite steadily; and that commodity prices fell, on the whole, almost as steadily. The net result to the laborer was that his real wages — the purchasing power of the money received — rose throughout most of the period.

Periods of labor unrest. During the World War wages followed commodity prices very closely in most countries and most occupations, until near the close of the period at least. A point is here brought up which requires attention, as going far toward explaining the periodicity of general labor unrest. It is brought out on comparison of

wages and commodity prices, over long periods of years, covering recurrent booms and depressions in trade and industry.

During the greater part of a cycle in trade, embracing a boom and a depression, wages seem to tend to rise and fall in close correspondence with commodity prices. But at certain periods in the cycle this close correspondence fails to operate, and at such points of the trade cycle we have acute labor conditions. There are in general two such friction points. One occurs near the end of a long boom, as at the end of the war when commodity prices are still rising but purchasing power is becoming doubtful. At such times there will be demands for increased wages, natural enough from the labor standpoint, but which the employer can not safely grant, because the prices of his products can not be raised accordingly. The second friction point comes near the end of a long depression, when there is actual temporary over-supply of labor; and at such times the demands are not for higher wages, but that work of some sort should be supplied, commonly at government expense.

These two types of labor disturbance are with us, at intervals, and seem likely to continue as long as business goes through periodic waves of prosperity and depression. Meantime, in the long run, real wages have increased steadily and largely.

The organization of labor. In these days, when large masses of men and money are employed industrially, it is obviously necessary that both labor and capital be held together in some definitely organized and integrated form. So, just as capital works through the medium of the corporation, so labor will be integrated in similar fashion. We may assume that in future we will always deal, not with individual laborers, but with a labor organization of some sort; the only question is to the form which this labor organization is likely to take.

The labor organization may be based on the trade as a

unit, in which case the final result is the trades union of today; or it may be based upon the shop or business as a unit. In the former case there are serious industrial disadvantages, looking at the matter merely from the standpoint of technical efficiency. A labor organization formed in this fashion has only one really effective argument or weapon — the strike. To make a strike effective there must be the closed shop, so that we finally arrive at the necessity for forcing all employes to join the union. With this, we reach two other difficulties, which both make for decreasing industrial efficiency. One is the general tendency toward limitation of output, the pace being set by the slowest possible worker. The other is the equally obvious tendency toward a freer employment of sympathetic strikes, or even of the general strike, as an end result of a purely local and individual labor dispute.

So far our greatest developments have been along the line of trade unions of precisely this type, ending in their combination as a federation of unions. This growth has been permitted under the law, so that now we face actual monopolies of labor in certain trades and occupations. But with increase in size and power come increases in responsibilities, both legal and moral; and these arise from the very facts of the case. A trade union is not a natural phenomenon; it is a body of workers, permitted by the State to associate for certain definite purposes, and to act as a body through its authorized agents. It has an unique status in one regard, for it is given the privilege of monopoly. If it be possible to persuade one hundred per cent. of the workers in any trade to join a union, there is not the slightest legal obstacle to such a course, yet an absolute monopoly is obviously formed in this manner. Now the necessary relations of the public and the State to a monopoly, however formed, are becoming clearly understood. When we discuss industrial corporations it is stated, without hesitation or fear of dissent from any

quarter, that if the state permits or encourages the formation of a monopoly of any sort it must be prepared to regulate the prices of the product and the conditions under which it is marketed. No body or class of men, entrusted with monopolistic power, is so entirely altruistic as safely to be left uncontrolled.

This reasoning, clear enough as applied to manufacturing corporations, must be equally clear and valid as applied to labor organizations. If a union, or group of unions, is permitted to form a monopoly in the labor supply for any given industry, it is clear that the State must retain and exercise the power of interfering in labor disputes, by forcible arbitration or otherwise. This is particularly the case when the dispute is likely to be wide-spread in its effects upon the community at large, as when it involves transportation or fuel supplies.

On the other hand, it is by no means necessary that the labor organization takes the form of a union made up of all the workers in a given trade. It may, just as logically, take an entirely different form, being made up of all the workers, of all sorts, in the employ of a given business or shop. This does not give the same opportunity for public display or political action, but it has certain advantages for industry. With a labor organization based on the individual business the interests of employer and employed are to a certain extent identical; and can be made very closely so if there be any proper attempt at working out a system of profit-sharing.

Whatever system may be finally reached, it will have to be borne in mind that our ultimate interest, from any standpoint, is to secure the greatest production of useful commodities with the least expenditure of human labor. That end represents the ideal for capital and labor alike, and for consumer as well as for producer.

It will be seen later, when we come to discuss the world competition of the future, that there is good reason for

anticipating a period when the economic pressure on the United States and Europe will be greatly intensified, owing to the competition of a newly risen Asiatic industrialism. When that time comes it will be very evident that it is to the interest of all of us that our own industrial machinery works with the minimum of internal friction and with the maximum of sheer technical efficiency.

CHAPTER XIX

THE DEVELOPMENT OF THE CORPORATION

In previous chapters we have spoken of industrial development, of its causes and its effects, without considering the structure of the units or organisms which really taken together, are responsible for this growth and these effects. We must now turn, therefore, from consideration of industry as a whole, to study of the manner in which its active units have developed in the course of the past century or so.

This question, like that of tariffs and socialism, has become so largely the subject of partisan politics and literature that it is difficult to realize its essentially normal characteristics. So long as we confine attention to any one country, or any one industry, we are apt to be misled by accepting local or individual characters as being of general occurrence; and on the other hand we are apt to ascribe entirely general and normal developments to the work of individual men or of particular government policies. But when we come to examine the field more broadly, we find that in all countries, during recent times, all large scale industries have shown similar tendencies toward growth along several lines, and that these tendencies have brought about, again in all countries, similar changes in business organization or structure. By studying the matter in this way we may perhaps keep clear from the dangers of local or class bias.

The evolutionary tendencies manifested everywhere in industry have taken two general lines of progress, and their effects are shown in two very distinct ways. Though great confusion of thought seems to exist regarding the relationship of the two series of effects, they are in reality very different, both in their underlying causes and in their visible

or material effects. It will therefore, make for clearness if we discuss them under two entirely separate headings, according as they are (I) processes connected with the growth of individual business units, or (II) processes involving combination or merger of different units.

I. Individual Expansion

All successful large scale businesses, in all countries, whether conducted by individuals, by partnerships or by corporations, show tendencies toward expansion of the business unit in certain definite directions. These lead respectively toward

a. Integration of the industry, by acquisition of supplies of raw materials or by taking up further finishing processes with the old products.
b. Increase in the size of the operating unit, by simple growth in capital and output.
c. Geographic expansion, by reaching out into new markets, domestic or foreign.

It should hardly be necessary to say that growth in the three directions above outlined is entirely natural for a successful business, whether that business be conducted by an individual, a partnership or a corporation. The general public has no interest in preventing or retarding such growth, and as a matter of fact has some interest in fostering it. The Government, of course, has no interest whatever in the matter, unless the expansion is taking place under a despotic government which needs money. In that case there will be some gain to the governing class, whether that class be an hereditary aristocracy or a pseudo-representative bureaucracy, in levying extra taxes upon industrial growth under the guise of regulation or license. These relations are summarized here so that there will be no necessity for referring to them later. Our chief interest is rather with the effects of industrial growth of the business unit itself, than with its exterior relations.

Progress of integration. Taking up the first of the industrial tendencies, we have to deal with the universal growth of integration in the larger industries. In the sense in which it is here used, *integration* is the process of building up an individual business unit (whether it be a firm or corporation) until it has acquired an independent position in all the stages of its industry, from the mining of its raw materials to the fabrication and sale of finished products. This process does not necessarily involve, at any stage, either the acquisition of competitors, the suppression of competition, or the control of prices. It is carried out to greatest perfection, indeed, under a purely competitive *régime*. Regarded economically, it is a purely natural and logical growth, restrained only by lack of capital or lack of enterprise, and it makes for economy throughout the entire series of manufacturing and selling operations. It has, moreover, no direct or indirect effect on prices, and carries with it no implication as to market control.

Until within the past decade no one, in any country, had ever suggested that integration had any evil effects either on the industry or on the consuming public. Recently, however, there have been direct attacks upon the integrating process. It is true that these attacks so far have related chiefly to one particular industry. But it happens to be a very important industry, and the criticisms of its integration were based on entirely general grounds. If they are to be accepted as logical in this particular case, they can be applied just as well to any other thoroughly integrated industry, whatever its nature or type.

The steel industry affords the best example of a business which has arrived at a practically uniform stage of integration throughout. This fact is rarely recognized in popular discussion, for the current opinion seems to be that one large corporation is the only business unit which has taken up all the possible stages of manufacture. It will therefore be well to outline briefly the actual situation, and

to show what are the possibilities and the actual results of integration in the American steel trade.

In the course of manufacturing a finished steel product, there are a number of stages in the manufacture, each of which could conceivably be carried on by a separate company. The following grouping is convenient, and sufficiently precise for our present purposes:

I. Ownership and mining of raw materials; including ore, coking coal, fluxing stone, etc.
II. Transportation of raw materials to blast-furnaces.
III. Production of pig iron in blast-furnaces.
IV. Conversion of iron to steel in steel furnace or converter.
V. Rolling of steel ingots into structural shapes, rails, sheets, bars, rods, etc.
VI. Further treatment of some of the products from V, by finishing into wire, nails, tinned sheets, etc., or by fabrication into columns, bridge material, etc.

It has been said that *conceivably* each of these six stages in the manufacture could be carried out by a different independent company. As a matter of fact, there have been times and localities where this ideal of sub-divided industry has been pretty closely approached. There are still a number of independent mines, railroads and finishing plants; so that stages I, II and VI are quite commonly carried on by companies which operate only one stage. There are also a few furnaces, mostly in the Middle West, which buy all their raw materials and sell all their pig iron in the open market, so that stage III, on an entirely independent basis, is still in existence. But with these relatively slight exceptions, all American and foreign companies engaged in the iron and steel business carry out at least two stages of operation, while the bulk of the world's steel output is made by a large number of highly integrated concerns carrying through at least five of the six possible stages.

In order to show the extent to which the integrating process has actually been carried in American and Canadian steel industries, the following table has been prepared. The data used are taken from various published authoritative statements, and though there may be slight errors or omissions it is believed that the table may be accepted as practically correct. They have at any rate been assembled without any preconceived ideas as to the rightness or wrongness of a condition which seems to be of purely natural origin and of practically universal occurrence.

EXTENT OF INTEGRATION IN THE AMERICAN STEEL INDUSTRY

Name of company or group	Stages Included under One Control								
	I			II		III	IV	V	VI
	Ore mines.	Coal mines.	Flux quarries.	Steamers.	Railroads.	Blast-furnaces.	Steel plants.	Rolled products.	Highly finished products.
United States Steel Corporation..	+	+	+	+	+	+	+	+	+
Lackawanna Steel Company....	+	+	+	+	+	+	+	+	+
Jones & Laughlin Steel Company.	+	+	+	+		+	+	+	+
Republic Iron & Steel Co.....	+	+	+	+		+	+	+	+
Colorado Fuel & Iron Company.	+	+	+		+	+	+	+	+
International Harvester Company.	+	+	+	+	+	+	+	+	+
Dominion Steel Company.....	+	+	+	+	+	+	+	+	+
Bethlehem Steel Company.....	+	+	+	+	+	+	+	+	+
Lake Superior Corporation.....	+	+	+		+	+	+	+	+
Midvale Steel Company.....	+	+	+			+	+	+	+
Nova Scotia Steel & Coal Co...	+	+	+	+		+	+	+	+
Virginia Iron, Coal & Coke Co..	+	+	+		+	+			
Thomas Iron Company.....	+		+		+	+			
Empire Steel & Iron Co.....	+		+		+	+			
Sloss-Sheffield Steel & Iron Co...	+	+	+		+	+			
Joseph Wharton, Inc.....	+	+	+		+	+			
Witherbee-Sherman Co.....	+		+		+	+			

The first group of steel companies included in the table represent the bulk of the North American steel output, and

it will be seen that they are all highly integrated, including in every case at least five of the six possible stages, and in most cases including all six.

The second group in the table includes a series of fairly representative companies, located in the east and south which make iron but not steel. In this case, there are only three possible stages of the industry, and on looking over the table it will be seen that every company of this group carries out all three stages, and that most of them carry out all the possible subdivisions of these stages. The railroads credited to them are, in a few instances, merely mine or plant connections of more than average length or standard of equipment; but in most instances they are even more than this, being chartered and operated as common carriers. Some of these lines are quite extensive, comparing favorably in size with those handling Lake ores. The Virginia and Southwestern Railway, for example, operates 162 miles of line. Until quite recently it was owned by the Virginia Iron, Coal & Coke Company; and when finally sold to the Southern Railway the transfer was not made because of fancied legal objections to the old ownership, but for quite other reasons.

A similar study made of conditions in another very important American industry — the manufacture of Portland cement — will show a remarkable similarity in extent of integration, but with two very striking points of difference. Practically every cement plant in the United States owns and operates its own limestone quarry, its shale, clay, or slag supply; and the transportation of these raw materials from quarry to mill is accomplished in almost every case over tracks owned and operated by the cement company. All the mill operations are of course under direct company control, and in some few but important instances the cement company ships cement in its own cars or vessels. So far the cement industry is thoroughly integrated. But two striking exceptions, as previously noted, remain to be con-

sidered. These are in relation to power and fuel supply, and to the finishing of the product. Very few cement companies own and operate coal mines; and practically all of them sell cement without attempting to absorb any of the profits to be made from the use of the cement. The cement companies correspond therefore to blast-furnace companies, and dispose of their product at a corresponding stage of finishing.

The advantages of integration. When the various stages in an industry have been thoroughly knit together under one control, so that the business is completely integrated, the result will be that a number of advantages and economies appear. Most of these will be small of themselves, though important in their total effect; and in most cases they will be commercial, rather than technical, in their savings. The contrary idea is often given in current discussions of the subject, where one very striking instance of a technical saving — the transfer of hot metal from the blast-furnace to the steel mill — seems to have made a great impression on all who have heard of it. So far as I know, however, this is one of the very few *technical* advantages of integration, the only other important one being the use of waste furnace gases in the power plants for the mills.

On the other hand, the financial or commercial gains, though not so readily seen by the visitor to the plant, are important and continuous. When a company handles all of its own stuff, from raw material to highly finished product, it can adjust its requirements and operations at every stage so as to secure the greatest ultimate economy. The raw materials used at each stage will be delivered in proper grade and quantity, controlled within the organization itself, and not subject to the condition and vagaries of the general market. In the long run, the steadiness and regularity of operation thus induced will show in the accounts.

With regard to the direct profits of integration, however,

something more must be said, for the matter is not so simple in real life as in public documents. In some recent discussions of the subject there is evidently present the idea that, by integrating an industry, some new and direct profits will mysteriously appear. This idea arises from fixing attention on one fact, and entirely overlooking another. The fact which is comprehended is that, in an integrated company, one concern secures all the intermediate profits which were formerly made by the producers of its various raw materials. The fact which is overlooked is, that in order to do this, it has been forced to assume all of the capital obligations of those former independent producers. The total profits of the integrated company are greater than before integration was complete, but its capital requirements have also grown, and in practically equal degree. There is no place in which new direct profits can appear in this series of transactions.

A simple specific case may make the matter clearer. Let us assume that a furnace company, which has been buying its ore from a given mine, acquires that mine and operates it directly. Now, if the ore was formerly bought at a fair price, and if the mine is bought at a fair corresponding valuation, it is clear enough that the ore-mining profits will correspond merely to the added capital outlay; and that the question of pig-iron costs or profits has not been changed in any way by the acquisition of the mine. What the furnace *has* gained by the transaction, however, is the certainty that its operations can now be carried on with absolute surety that its supply of this one important raw material will be under its own control, and that it will be shipped as needed, both as to quantity and grade. The gains are, as seen from this instance, not direct but indirect.

We might even go further and say that, during certain times in our periodical business cycles, a furnace buying its raw materials in the open market will make more money than if it had its own supplies. This is due to the fact that,

in times of stringency, the smaller mines will sell at close to sheer mining cost, disregarding depreciation and all other theoretical costs, and offering their best grade of ore in order to attract purchasers.

The legal status of integration. It has been noted that until within the past few years no one ever seriously questioned the advantages of thoroughly integrating a business or industry. The advantages to the company were obvious, and as the process did not involve suppression or even lessening of competition, there seemed to be little reason to apprehend public disadvantages of any sort. Neither the courts nor the legislatures had ever looked with doubt or apprehension on the process, and no statues had been enacted or suggested looking toward its regulation or prohibition. Legally, the status of integration is therefore absolutely clear, with one very individual but very important exception. The exception noted arises from the fact that, in legislating to prevent an entirely different condition, one stage of the integration process in the steel industry may have been unintentionally affected. The element concerning which this doubt exists is the common ownership of industries and transportation lines. As a purely legal question it will be settled by the courts, and needs no discussion here.

Passing from the question of the existing legal status of integration to that of its relations to a sound public policy, it may be suggested that there is nothing in the integration process itself to which anyone could possibly take exception. As already pointed out, it does not necessarily involve the acquisition of competitors, the suppression or lessening of competition, or the control of prices.

So far as public policy is concerned, there is therefore little reason to believe that it would be to the public advantage to have the different stages of steel manufacture carried out by separate companies. As a matter of fact, the objections made against the policy of integration seem, in

reality, to be based on a misconception or confusion of ideas. If any company has acquired complete control of any given stage in steel manufacture, so that its competitors have to look to it for their supply of either raw materials or semi-finished products, there would be reasonable ground for criticism. But in that case the criticism should not be directed against the policy of integration, but against the fact of monopoly in the given stage of manufacture.

Even regarding the control of transportation systems, which is the stage of integration most open to criticism, there is something to be said in its defense. In every case known to the writer in which an iron or steel company owns and operates a rail or water line, the railroad or steamer was built for the purpose of adding to transportation facilities, and was not purchased for the purpose of decreasing or monopolizing them. In many cases, the new transportation system opened up new sources of ore or coal supply, from fields not adequately served by any existing system. Under these circumstances it is obvious that, whatever may be the current view as to the public policy in regard to common ownership of transportation and industries, there can be little question or criticism of the causes which have brought about the present condition.

Larger operating units. Second only to integration in its total importance, and probably outranking it so far as actual manufacturing economies are concerned, is the expansion in size of the operating unit up to its point of maximum efficiency. Growth in this direction is entirely normal, and is apt to be accomplished without much attention being paid to it except by those directly interested in the industry. Up to a certain limit, varying with the character of the process, expansion in size of unit shows a steady gain in efficiency due chiefly to reduction in overhead charges per unit of output; while at intervals in its progress it will show sudden gains, due to the fact that at certain stages it becomes possible to introduce new economies.

If, for example, we assumed that a single furnace, operated independently, was added to until finally there were ten or twelve stacks under one control, it would be found that the average cost of making a ton of pig-iron would tend to decrease slowly but steadily as the installation increased in size. This steady decrease would be due to the fact that, to a large extent, the necessary labor, supervision, and capital would not increase as fast as the output. On the other hand, at certain stages in this growth there would be additional and less regular savings, as at the points when the installation was large enough to justify the use of its waste gas or its slag in some profitable way. The expansion in size of operating unit would therefore lead both to technical advances and to decreases in operating costs.

Geographical expansion. The third tendency in modern industry, and generally the one which appears latest in the history of any business organization, is toward geographic expansion. After thorough integration of the business has yielded all the economies of which it is capable, and when its plant has attained maximum size so far as operating efficiency is concerned, it is found that there are further advantages attainable by growth in another direction. This will be along the line of building other plants, so located as to reach new markets, or at least to supply portions of the old markets on a more economic transportation basis.

Unless we are dealing with light and relatively costly articles of manufacture, the freight charges on the finished product between mill and consumer will often amount to more than the mill cost of the product. This is particularly so in the case of some of the great staple products, like pig-iron and cement, which are made and sold for a very low price per ton. It is obvious that in dealing with such products the cost of transportation between mill and consumer may easily amount to a very large portion of the price finally paid by the consumer.

Under such conditions, as the business and its markets grow, there will finally come a time when it will be advisable to build new plants, at new localities, to serve the more distant portions of the present market at lower freight costs, and to develop new markets if possible. Geographic expansion therefore normally results in an increase in producing capacity, and not in a decrease; in an increase in competition, and not in a restraint of it.

II. Combinations and Mergers

In the preceding section it has been pointed out that all large-scale industries in recent years and in all countries, have shown the same tendencies toward growth along certain lines. It was further shown that these processes of growth were a natural development, that they affected merely the business organization of the respective industries, and that of themselves their effect was rather to increase than to diminish the sharpness of competition. Anyone who has been engaged in one of these rapidly growing industries will recognize the painful truth of the last statement particularly. With each period of business prosperity new plants are built, and old ones are increased in size. With each following period of business depression, the struggle for the contracting market becomes more severe, and prices are cut savagely to get enough business to keep the organization intact. Finally, when this has gone to the extent that a few of the best-equipped and best-located plants can supply all the market that is left, at prices not far from cost, the process necessarily ends.

The causes of combination. In the days before power machinery was in use, the entire matter settled itself more promptly and more decisively, but also more cruelly. For in those days the productive capacity of any locality or industry was limited solely by its labor supply; and over-production was met by a decrease in this supply. A relatively

short period of depression resulted in the starvation or emigration of the "productive capacity," and business could again start on a firm footing. But in these days of machinery surplus capacity does not disappear so easily, and the stages in our business cycle seem to come to shorter intervals.

In order to meet these conditions, which seem to be a necessary accompaniment of large-scale industry when left unregulated, producers in every line of industry and in every country have attempted, at some time or another, to regulate in some way the wider fluctuations of the markets. These attempts were not ordinarily made with any monopolistic intent, but were taken up as a matter of sheer self-preservation. In some countries the Government has actively aided in these attempts at coöperation and regulation; in others it has been merely a passive spectator; in a few, including unfortunately the United States, it has taken an active part in opposition.

For our present purposes we may speak of these attempts at coöperation as *combinations,* whatever may be the precise legal or illegal form which they may have assumed. They may, for example, have been simple and temporary pools, more permanent and closely tied syndicates or cartels, or complete mergers. As a matter of fact, the form taken by combinations in different countries depends largely upon the attitude of the Government toward industrial development. The desire for individual ownership is so strong and so persistent that, except in countries where pools and cartels are prohibited, extensive mergers rarely occur.

A movement of this type, toward some degree of combination within the industry, is practically universal. It is not confined to high-tariff countries, despite common assertions to the contrary. It is not confined to industries where the individual companies are of large size, but is found in many of the characteristically small-scale industries,

as in the retail trades. The drug, grocery and drygoods trades would probably furnish more examples of price agreements and combination than would any of the larger scale manufacturing industries.

In a recent study of existing tendencies in British industries, McCrosty has summarized strikingly the underlying conditions under a *régime* of unrestricted competition which inevitably tend to bring about some degree of combination or coöperation in all modern industries. I have quoted this summary elsewhere, in discussing the condition of another American industry, but the statement is so concise and immediately applicable to conditions in the United States to-day that it is not necessary to apologize for introducing it again:

> With every improvement in transport the market becomes wider and competition becomes keener through the advent of new producers, while at the same time it becomes more difficult to make rational forecasts of the course of trade. Even within tariff walls competition always rages as soon as it is discovered that there are certain industries to which the law has assigned the possibility of greater profits than the average. Alike in protected and unprotected markets free competition becomes cut-throat, prices fall, and over-production ensues in the wild efforts of producers to reduce costs by a larger output. . . . One might say that the normal course of modern trade was that prices should always tend toward the cost of production, that this tendency developed itself with increasing speed, and from time to time ended in production at a loss. Now, whatever one may say about a "social contract," or the working out of the welfare of society through the clashing self-interest of individuals, the fact remains that the first object with which a man enters business is to make money, and his second to make as much as he can. Similarly a workman wants first to get a subsistence wage, and next as high a wage as he can. And if any social institutions or trade methods stand in the way there will be a revolt. Such a revolt in a multitude of forms we are now witnessing.

The advantages of combinations. It must be admitted, however, that random statements and faulty arguments are not always confined to one side of the discussion. The advocates of combination, regulated or unregulated, are just as apt to present unfair reasoning as are the advocates of unrestricted competition.

Disregarding all of the more doubtful claims which have been advanced, there are certain advantages which can fairly be expected to result from combinations. These are:

I. Advertising, selling and other marketing expenses can ordinarily be heavily reduced, particularly in the case of the bulky and well-standardized staples, such as iron, steel, cement, etc. The extent to which these savings can be carried will depend on the form which the combination has taken.

II. Business depressions can be met with less actual loss, for the output can be reduced gradually and prices steadied as the market narrows. Combinations cannot prevent business depressions, but they can mitigate some of their worse features.

III. Overbuilding can be prevented, and the capital which would otherwise be lost in unprofitable plants can be saved. This is true only of certain types of combination, and its importance then will depend almost entirely upon the farsightedness of the combination management.

IV. Excessive prices can be prevented, with far greater ease than under competitive forms of industry. But, with human nature as it is, it would be unwise to hope for too much in this direction from the average combination, unless there is some machinery, legal or natural, to aid in preventing excessive prices. This machinery may be put in motion by an industrial commission, or in some cases it might be worked through almost automatic tariff changes.

V. If the combination is carried to the extent of absolute merger, it will also benefit on a larger scale from the advantages which have been described in the previous sections

on integration and geographic expansion. This however, is not inherent in the idea of combination, and can not normally be considered as a part of its necessary gains.

It is obvious, from our statement as to the character of the gains brought about by increase in size, that there must come a point at which these gains are overcome by losses due to the growing inefficiency of handling so large a mass. This point is difficult to define, in terms of dollars or tonnage, but it seems to have been reached in the case of some of our larger corporations, where either the size of the component units or the mass of the final corporation is so great as to give inefficient results as compared with smaller competitors.

For in a corporation, as in the body politic or in an army, by far the great majority of the men involved are not expected or required to think or plan, to direct or invent. That part of the work falls on one man, in the last analysis, and upon relatively few men at the most. This is true of the mine and the mill, but it is almost equally true of the Board of Directors or the Finance Committee of any normally managed company.

It must be noted that this is not a criticism of the corporate form of doing business, but rather the contrary. It is not that a corporation is worse than a privately conducted business with regard to this particular limitation, but that either corporation or individual business will some day reach a point at which further expansion is uneconomical, owing to difficulty in handling it. And this furnishes one of the strongest real arguments against either private monopoly or government operation of any large industry or utility. In a privately managed business the inefficiency which finally arrives, is paid for by that particular business unit in the way of lessened profits or actual losses; it does not react on the industry as a whole or on the community at large; and it becomes visible to the owners of the business through comparison of their results with those of more

efficiently managed competitors. If the industry were a monopoly, however, either under private ownership or under government control, there would be no standard with which its results could be compared, and no possible check upon its growing inefficiency.

CHAPTER XX

LEGISLATIVE HELPS AND HINDRANCES

In the preceding chapter the natural tendencies of growth in modern industries have been discussed, so that we can arrive at some idea of the form which modern industrialism would be likely to take if not subjected to external check or interference. But as a matter of fact, through all the history of industrial development in all countries, we find that such entirely free growth does not take place, for there is always another force at work, external to the industry. This force is the power of the state, and it will be interested to consider to what extent and in what forms it acts upon industrial development.

Points of contact. It is clear enough that conflicting theories as to the relation of government to industrial development have acted in many ways to aid or retard such growth as has occurred. The bases and ultimate implications of these theories will be discussed later, but here we need only note that the chief contact points between government action and industrial growth are along the following lines:

1. The Government may, or may not, assume some degree of control over the units which compose any given industry. This control, expressed through corporation laws, may limit the size of the unit, its method of capitalization, and other features of its corporate life.

2. The Government may, or may not, afford direct aid to industrial growth through the medium of a protective tariff, of bounties, or of export differentials.

3. The Government may ignore attempts at combination or market control, it may oppose them, or it may aid and supervise them.

4. The Government may, finally, directly own and operate certain types of utilities, of natural resources or of actual industrial units.

The initial bias. The political conflicts which are carried out in all democratic countries are largely guided by opportunists, who appeal chiefly to the passions or emotions which can most readily be aroused at the moment, and which promise the greatest temporary advantage. The low level of political discussion serves to cover up the fact that there is, under all these conflicts, a real intellectual difference between the initial assumptions of the conflicting theories. This is not of course realized by the considerable fraction of any population which is born fully endowed with political and religious convictions, for with people of this type accident of birth determines whether they are free traders or protectionists, individualists or socialists, Methodists or Mormons. But with all other people, who arrive at conclusions after more or less definite reasoning, the choice between conflicting political theories on any point is, after all, made as a consequence of a choice between certain alternative basal assumptions. The fact that these basal assumptions are rarely or never put into words does not affect the validity of this statement, for it will be seen that once the initial basis is accepted, the later steps follow in natural and necessary sequence.

Before we go on, therefore, to discuss particular acts and theories of government, we must give at least brief consideration to the ultimate basal principles on which such particular theories or acts are founded. For our present purposes it will be sufficiently clear and exact to call the two opposing basal ideas the Individualist and the Nationalist standpoints, respectively. The theory and the consequences of each of these alternative standpoints may now be taken up in turn. It will be seen that each is defensible. We may accept either, but we cannot accept both; and once accepted, there are in each case certain necessary consequences.

The Individualist standpoint. From the Individualist standpoint, the highest aim of government is to assure absolute freedom of choice and action to the individual, subject only to the provision that infringement on the freedom of others must not be permitted. Applied to industrial problems, this implies necessarily that the Government should be entirely passive, placing no obstacles whatever in the way of free movement and action of money, of labor, or of trade.

Internationally, this attitude implies free trade in all commodities, so that ultimately manufacturers would gravitate to the regions or countries of cheapest production. It also implies that capital should be free to migrate, so as to find the country where it could be most profitably employed at the moment. But it finally implies that labor also should be free to desert countries of low wages and equally free to enter countries on a higher wage level.

Internally, the Individualist standpoint requires that capital should be left free to compete or to combine, as seemed most profitable to the individual capitalist. It also implies that labor should be equally free; and that the relations between capital and labor should not be interfered with by the state. It is opposed to state regulation of working hours, even for children; or of working conditions, even in dangerous and unsanitary occupations.

Although Individualists rarely realize it, their basal ideas necessitate the possession of certain quasi-religious beliefs, in which they do not differ greatly from Socialists. Either doctrine, pushed to its logical conclusion, implies a strong belief in the perfection or perfectability of human nature, and in the maintenance of international peace.

The Nationalist standpoint. From the Nationalist standpoint the highest aim of the Government is to secure the safety and happiness of the community as a whole, infringing as little as possible on the freedom of the individual in so doing. Applied to industrial problems, this implies that the Government may take an active part in furthering trade,

in settling or preventing labor troubles, and in preventing monopoly.

Internationally, this attitude implies that protection may be adopted, for one or many industries, if the interest of the whole nation seems to justify an attempt to create or foster such industries. It implies also that limitations may be imposed upon immigration, should such immigration threaten to bring about undesirable working or living conditions for the citizens of the nation.

Internally, Nationalism implies that the test in all questions is whether or not the proposed action will make for national security and general interest. Combinations of labor or capital may be permitted, but regulated in one way or another if they approach monopoly power. Working hours and working conditions may be regulated by law, because evils in this regard will weaken the state ultimately.

As to its other implications, Nationalism accepts humanity as it is, with the hope that it may improve, but with the certainty that the state can not wait until such improvement takes place. Nationalism is also willing to accept the hope that in future wars may cease, but it is not willing to risk the safety of the state on the fulfillment of this hope.

The choice of position. As between the two standpoints which have just been summarized, the choice must be made with clear knowledge of the fact that we are living in a real world, made up of different nations, inhabited by peoples of varying degrees of intelligence, education and moral standards. This recognition causes some consideration of the forms which the two rival theories of state life may take when accepted by different national types or classes.

Individualism, it can be seen, would in a perfect society develop along lines unexpected by its earlier adherents, and in such a society might take the final form of a very happy socialism. With people of more normal type it would, on the contrary, be more likely to end in savagery. For, if we admit that questions as between two competitors, or two

social classes, are to be settled by struggle, unregulated by the state, we have admitted all the requirements of the syndicalist.

Nationalism, on the other hand, has also its dangers if carried to extremes. For we may easily go past the point of having a natural pride in our own country to the foolish point of believing that we can best live entirely isolated; and down that path we can go to the end where lay old China. Or, filled with the missionary spirit, we might decide to force other countries to acknowledge our excellence, and down that path we can go to the end where lies Germany.

In a later chapter we may take up again the progress of political ideas, in their effects on future world leadership. Here, having discussed the basal ideas on which current political theories depend, we may turn to consideration of the ways in which different countries, at different times, have applied these theories in dealing with the progress of modern industry. It will be seen that the three leading industrial countries have approached these problems from widely different standpoints, and with widely different practice as regards many important points.

Government policies; Great Britain. In Great Britain, after the close of the Napoleonic wars, industrialism received a fresh impulse toward development, and this in turn reacted on political relations. A slow but steady growth of agitation for reform can be noted from 1815 onward — of reform both in purely political and in fiscal matters. Meeting with little success until 1830, the next few years found the first reform movement in command of the field. Between 1830 and 1835 Great Britain broadened and purified the electoral franchise, abolished slavery in the colonies, passed the first laws regulating child labor in mills, and made the first general appropriation for state education. With the intervention of a brief period of reaction or rather delay, the movement took fresh life in the

years 1842–1846, which were marked by the adoption of the income tax as a really permanent feature of British fiscal policy, and by the adoption of the policy of free trade.

During the sixty years following this gain little progress was made in the way of new legislation, though fresh problems were being accumulated by the steady growth of the industries. There was during this period, in theory at least, a certain tendency toward a reaction to individualistic ideas. It was felt that the less of Government intervention the better, and English parties separated on foreign policy, on church matters, or on Irish questions, rather than on industrial policies. In the meantime the courts had taken positions which gradually defined the attitude of Great Britain toward combinations — an attitude which differs from both those of Germany and the United States. Essentially it consists in holding that though business competition must be fair, it may be legally carried to its logical extreme of killing the competitive trade; and that though combinations have no direct legal sanction, they are not necessarily subject to legal penalty. This general attitude of *laissez faire* corresponds fairly well to the position taken by the United States prior to the passage of the Sherman Act.

After the close of the Transvaal war, an entirely fresh Liberal program was offered to the British public. Reform in many different directions was promised, and since the accession of its supporters to office most of these promises have been carried out. It is still too early to hazard a conjecture as to the ultimate effect of these very radical changes in English policy. Most of them were undoubtedly urgently needed if Great Britain was to secure a reasonably contented working population, on which her very existence as a nation depends. On the other hand popular reforms, under universal suffrage, can rarely be expected to stop at a reasonable point.

As to direct help in the past, Great Britain has been on a strictly free-trade basis for many years, though all of her

larger industries were founded under a protectionist regime. Practically all the Dominions have adopted protective tariffs and in some cases direct bounties. Before the World War there was the commencement of renewed agitation for protection in the home country itself, and it seems certain that one of the main effects of the war will be the adoption of that policy by Great Britain.

As to corporation control, a fairly strict Companies Act, aided by the very rigid enforcement of laws regarding company management, promotions and unfair competition, has been of service in preventing some of the normal features of unregulated corporation growth.

The Government attitude toward combinations, for over half a century, has been at least not hostile. The courts have taken increasingly broad views as to the type of agreements that can be considered legal; and while mergers and consolidations have accordingly not been carried out to the extent shown in the United States, more or less formal pools and price agreements seem to be in force in every important British industry.

Government policies; Germany. The German Government, whether old Empire or new Republic, has never taken the comparatively passive attitude toward industrial development that was long so characteristic in Great Britain, but has on the contrary actively assisted in such growth.

As regards the form and control of the business unit, strict supervision is maintained over incorporation, while rigid enforcement of other laws tends to prevent unfair methods of competition. In opposition to the English common law attitude, the German courts hold that contrasts in restraint of trade are enforceable if the particular contract does not tend to injure the state. The result of this is that relatively few mergers or consolidations occur in Germany, most industries being held together by cartels or trade agreements, in which the Government itself is fre-

quently a member. This is particularly the case with regard to coal trade cartels, which the Prussian and other state governments enter as owners of operating coal mines.

In Germany the movements toward industrial and social reform took rather unexpected forms, since they were considered by Bismarck as simply necessary factors in a more important work. The whole matter illustrates well both the advantages and disadvantages which a modern state receives from the long-continued control of a single great man. To the Chancellor, the national unity of Germany and its maintenance against foreign aggression were the only things worth considering; and it was further implied that this unity must be maintained under the almost absolute rule of the house of Hohenzollern. The aims were clear and distinct, and they were carried out in a way which, on the whole, did well for the nation at large. But in order that these aims might be accomplished in a modern state, it is obviously necessary that the mass of the population must be contented and prosperous, this being particularly a necessity in a country whose defense, thanks to the absence of naturally protected frontiers, requires a large army.

All industrial, social and political problems were consistently treated from the point of view which has just been briefly outlined. Socialism was to be discouraged and repressed, as tending to weaken Germany against external aggression, but the complaints which had given rise to socialism were to be met by remedial action. Manufactures were to be encouraged in every possible way not only because of their direct influence on the wealth and prosperity of the country, but because they were the only means by which a large population could be maintained within the limits of Germany. To this end protective tariffs were adopted, the export trade was directly encouraged and trade agreements and combinations were made not only legal but official. On the other hand, the laborer was to be protected against the

hardships of modern industry, which implied strongly paternal attitude so far as education, old age pensions and risk insurance were concerned.

This policy, first definitely adopted by Bismarck after his final break with the Conservatives, in 1878, was followed consistently by his successors; and the result is modern industrial Germany. Lawyers and politicians may criticize the policy — but the efficiency of the final product can be judged fairly only by its competitors in war trade and industry. From that point of view we may admit that the work of German reconstruction was painfully sound and complete.

Government policies; United States. The history of the United States up to the time of the Civil War, is merely the story of attempts to make a group of machines run steadily and uniformly without any central source of power or regulation. The attempt was finally abandoned in 1861, in practice if not in theory, and since that date no party has shown any serious interest in reviving the experiment. Of the two groups of States which entered that war, both emerged as centralized governments — and the one whose basic theory was State's rights was the more absolute and centralized of the two. The effect of the earlier theory was to give a series of contemporaneous policies with regard to public questions, rather than one general trend. Since the war these differences have gradually disappeared, and from now on we may fairly expect that in the broader treatment of industrial and social problems there will be some approach to unity throughout the United States.

The conditions which have been outlined in the preceding paragraph make it difficult to summarize adequately the general trend of development which industrial policies have followed in this country. With regard to the questions of protection and free trade we may say that in general the policy of protection has been adopted, though there have been several reversals of more or less temporary nature. It is probably, however, too early in the history of American

development to assume that free trade will now be adopted as a general and continuous policy.

During the earlier periods of American development there seems to have been a predominant feeling that industrial growth should be encouraged both directly and indirectly; and little effort was made to hinder the progress of integration and combination. About twenty years ago, however, a marked reversal of public sentiment in this regard seemed to be in progress; and in the period since then we have had much destructive criticism and few constructive suggestions. Prior to the passage of the Sherman Act, combinations had no legal sanction; since its passage they have been legally penalized. The Act was somewhat indefinite in its real bearing, the offenses defined have not been generally considered morally wrong, and its general effect has hitherto been somewhat indecisive. With a clearer interpretation and rigid enforcement it will become a decisive factor in American industrial development or retrogression.

One question requires more consideration, for the relation of the Government to market control has been both important and variable. Four dates seem to mark out different periods in the history of this matter. These are 1890, when the Sherman Act was passed; 1894, the decision in the Knight case; 1899, the passage of the revised General Corporation Act of New Jersey; and 1904, the decision in the Northern Securities case. The more recent decisions in the Standard Oil and American Tobacco cases, though widely discussed, do not seem to have materially changed the situation.

Prior to the passage of the Sherman Act, pools and other loose and temporary forms of price-making agreements were in common use in all industries. When cases involving them came up for decision, the courts, following the common law, steadily held that such agreements were unenforceable. This tended to weaken their efficiency, but

hardly restrained their formation. The Sherman Act, however, put the matter on a different footing, by making such agreements criminal in place of being merely extra-legal; and from 1890 on other forms of combination became more prominent. The decision in the Knight case seemed to suggest one way out of the difficulty, and the passage of the New Jersey General Corporation Act in 1899 made it possible, for the first time, to form a holding company under general statutes. Until the Northern Securities case was decided, in 1904, the situation seemed to have been cleared. That decision, however, again involved the question in doubt, from which the country has not yet emerged. The several cases later decided have not, contrary to a somewhat general impression, thrown much light upon the really important questions at issue, for these recent cases were not simple but complex. They involved not only consideration of the general question of combination, but the specific instances in which unfair practices in competition were charged. Under these circumstances the decisions reached can not be accepted as applying necessarily to corporations of large size but with clear records so far as criminal acts or intentions are concerned.

PART IV

THE FUTURE OF INDUSTRIALISM

CHAPTER XXI

THE NATURE OF THE PROBLEM

In the first part of this volume we were able to follow out the growth of modern industrialism from the time of its inception in England, about 1770, to its condition in the leading industrial nations at the close of the World War. Following that historical study of the matter, examination of the material bases and resources upon which our modern machine civilization rests threw light upon the extent and unequal distribution of these resources, and upon the extent to which they have aided or limited the industrial growth of different nations. In still later chapters there was discussion of the varying rate at which industrial growth has taken place at different periods in our history, and of the factors which seem to have been most influential in inciting particularly rapid growth at certain times. Among these, we found that access to new markets, often appearing in consequence of geographic discovery, of colonization or of transport improvements, was perhaps the most important single factor in commencing such periods of world-wide commercial and industrial activity. The technical progress made in industry, which has resulted in vast improvement in the physical well-being of all the world, was also found to be not constant, but spasmodic or rhythmic in its occurrence, and to depend in large part upon the general activity of industry itself. Certain other factors which have aided industrial expansion, such as population increase and gold supplies, were examined, with varying effect. Finally, attention was paid to the form taken by the industrial organism itself, as a natural consequence of growth, and to the manner in which both this organic form and the extent of

industrial growth had been affected by political theories and practice.

Throughout all of this study there has been an attempt to avoid purely local treatment, so that national bias may be avoided, and the results obtained be general in their validity and application. In doing this, it has been found possible to discuss the general subject of industrial growth without laying undue stress upon the effects of particular government policies, or the work of individual men, in either aiding or retarding such growth. The development which has come to pass in many countries is found to be natural in its origin and in its effects, and to show little trace at any stage of conscious human planning or intention. Business units, industries, and industrial conditions — all of these have grown up, in different countries, along much the same general lines of development. The causes which incite this development are widespread, so that all the world exhibits the same tendencies. But inequality in natural resources has operated to favor growth in some regions, and to retard or actually prevent it in others; while the rate at which development takes place is affected to some extent by conscious human action.

Having thus established certain factors which have caused, aided and limited industrial progress in the past, it should be possible to apply the same method of study to the problems of the present and of the immediate future. Since our conclusions have been reached by study of accumulated historical fact, they should have a validity greater than if they had been derived by deduction from a pre-conceived theory. And since the facts so utilized have not been limited to those shown by the history of a single race or nation, the conclusions should be applicable even to the entirely new arrangement of nationalities which the world has now to face.

We are interested in reaching some just conclusion as to the probable course of national and international progress

during the decades immediately ahead, with particular reference to the course of industrial development during that period. But we see, as soon as we recall the factors which have influenced industrial progress in the past, that any forecast based solely upon the condition of industry itself would be of little service. In order to secure results of any real value the scope of the inquiry must be widened so as to include some consideration at least of the probable course of political development in the competing industrial nations, for this will influence very markedly indeed their industrial growth. And we must also take into account the possibility, or probability, that another war of wide scope may intervene to wreck our calculations. Aside from these external factors, we must of course pay still more attention to those which arise from industry itself, and from the natural conditions which incite and limit development.

At the outset, we must recognize very clearly that the problem of future industrial development and future rivalry is not merely a continuation, after a five year break, of the problem which existed in 1914. It would simplify matters greatly if we could assume that this were so, and that the world of to-day is merely a little older than the world of before the war. But such a simple conclusion would be most widely at variance with the truth, and its acceptance could only lead to disaster.

When we come to consider either national development or international rivalry, in trade or otherwise, we could therefore commit a profound error by assuming that in either case the old conditions still exist. We have in truth to deal with a new world, not new in the sense that there has been any profound mental or moral uplift, as idealists hope, but new in the sense that all material conditions have been subject to change and rearrangement, that the social and industrial structure has been badly shaken everywhere, and that in some great nations these structures have been practically shattered. Under such conditions new ideas

will arise, and these must be taken into consideration.

It will suffice, for our present needs, to outline briefly the nature of some of the new factors which must be taken into account, and which will in later chapters be discussed in more detail. There is the fact, first of all, that we have now a very poor world, as compared with that of before the war. The destruction of real wealth, in human lives and material property, has been great beyond anything ever before seen or anticipated. Later we shall attempt to come to some estimate of what this destruction amounts to, and also as to what it implies in the way of social and industrial changes. Second, we have the fact that not only the three leading industrial nations, but several weaker European countries are loaded down with government debts to an extent entirely unprecedented. This condition can not be passed over with the mere statement that these government debts will ultimately be carried as individual debts of the citizens, and that they are even now equalized by individual ownership of the government securities which were issued against them. That statement is true enough, so far as it goes, but it does not touch the real crux of the matter. It is true that the government debts will finally be taken up by means of taxes, capital levies or frank repudiation — for all of which there is ample warrant, even in our own history. But in this process, the methods employed will operate to cause friction between classes, and re-distribution of individual wealth, to an extent which will certainly produce marked industrial and perhaps political effects.

Further than these two broad changes which have been brought about by the war, we have the facts that many new little nations have been created, and several old ones dismembered, temporarily at least. And in the course of these territorial and racial rearrangements, there have been incidental but far more important changes in the national control of various important resources — coal, iron ore, petroleum. These changes have been far greater than appears

to be commonly realized, to the extent that some of them will affect profoundly the course of the world's history, political as well as industrial.

There are, finally, certain features of recent industrial growth which seems to suggest that in the near future there will be marked changes in both the rate and trend of development. Such changes would affect not only our industrial structure but also our existing social arrangements, and are therefore worthy of careful study, even though the final results of such study may be suggestive rather than conclusive.

Taking all of these important factors into consideration, it is evident that in order to arrive at conclusions of real value, we must weigh in turn each class of facts likely to affect the result, and then attempt a synthesis of these partial conclusions. For the sake of clearness in presentation this will be done by taking up the different subjects in the following order, making up the remaining chapters of this volume:

Chapter XXII The progress of political beliefs.
Chapter XXIII The trend and rate of future growth.
Chapter XXIV The factors of world competition.
Chapter XXV The future of world competition.
Chapter XXVI Industrialism and war.

To which will be added, as a brief summary of the apparent trend of development politically and industrially

Chapter XXVII The forms of future progress.

CHAPTER XXII

THE PROGRESS OF POLITICAL BELIEFS

As with advances in other departments of human thought and activity, men's notions concerning the proper form of government, and the necessary or permissible scope of state activities, show a certain rhythmical progress. The advance is not persistent, but is subject to periods of inactivity, or even of more or less serious reaction; the direction of the advance is not always immediately obvious, so that looking back over a long period we can see that the development ultimately took a course differing somewhat markedly from the direction of the separate movements which, at different times, seemed to be in the ascendency. A new school of thought arises gradually, offering a new theory or advocating a new program; its influence increases until it seems to dominate its sphere of knowledge or action completely; and it effects advances in legal and social practice along certain definite lines. But even while this is happening we find that real conditions have changed more rapidly than human thought, and that by the time the new program is generally accepted it is seen to have lagged behind the development of external conditions, and to be antiquated as compared with its existing environment. Progress has been made, it is true; but unexpected defects in the program have developed, and unsuspected forces have been at work, and the gain has not been as definite and final as had been hoped. So the search for an ultimate formula recommences, and naturally first shows itself in a violent reaction from those portions of the generally accepted theory which have proven most obviously unfitted to existing conditions. Looking back over a series of such advances,

the whole course resembles the path of a vessel tacking in order to gain some desired point. Each leg of the course diverges violently from the preceding one; each involves some loss of distance laterally; but taken together there is a general and sustained advance toward the goal. In adapting this comparison to the progress of thought and legislation on economics and political questions we must add to it the qualification that there come, at intervals, long periods of relative calm, when neither activity nor progress are noticeable, and that these alternate with periods of intense activity culminating in rapid advance. These alternating periods of quiet and advance have a curious and important effect upon the relation of current theory to actual fact. For, since it requires ordinarily at least a generation to permit the general adoption of a new theory or program, it is only during one of the long periods of calm that we find accepted theories to be fairly in accord with existing conditions. It is only when external conditions have been comparatively unchanged for a long period of time that current views are in accord with them. During periods of rapid change there is a marked discordance between theories and facts; for the normal condition is that the generation trained to accept one view will hold to it long after the conditions which justified it have passed away.

Every nation has attained its present stage of political and industrial development in purely natural fashion, and the extent and form of such development has in each case been determined largely by natural conditions, and but little by conscious intentional direction. It would therefore be a serious error to attempt to force existing stages of civilization into conformity with some pre-determined Theory of the State, or to try to bend existing commercial conditions to fit a pre-determined Theory of Trade. On the other hand, it will be well to avoid falling into the opposite error of entirely disregarding the effect of law and

theory upon the form which institutions have assumed at different periods and in different countries. Theory has in the past exercised a powerful though not a decisive influence upon the course of development; and it is with one such instance of the reaction between theory and fact that we have now to deal.

The passing of individualism. Sixty years ago it was still possible for the keenest of thinkers to accept a purely individualistic conception of government, as opposed to state regulation or intervention. Applied by Adam Smith during the latter part of the eighteenth century to purely economic problems, the idea of Government non-interference was extended by Mill and Spencer to purely political matters. The names of the advocates of this theory are still of influence, but it would be foolish to permit admiration to pass into fetichism. A great philosopher would certainly be the first to remind us that governmental institutions must be suited to their environments, or else perish; and that change in external conditions must of necessity involve corresponding change in political institutions. For in this one great respect political evolution differs from purely physical evolution — in that through the medium of laws it may to some extent be directed in advance toward the realization of an ideal. This possibility must be borne in mind, even though we admit that uncontrollable developments will operate to reduce the extent to which such intelligent direction of political evolution is possible.

In considering the influence which the individualistic theory has exerted over our past practice, it will be well to recall that in its most striking form that theory dates beyond the middle of the last century. Its justification at that time may be better comprehended if we briefly summarize some of the conditions which gave it birth. The English theorists of that period had to deal with conditions which, at the moment seemed essentially fixed. From Waterloo to the Crimean War there was substantial peace

in Europe, accompanied by a reaction toward absolutism on the Continent and by extensive industrial development in Great Britain and America. The contrasts which could then be drawn seemed to point to a very obvious conclusion — that the more a Government interfered with its citizens, the less there was of substantial justice and freedom and prosperity. Both ethical and material arguments appeared to justify this conclusion; and it was accordingly embodied in a Theory of the State which gave it definite form. It was assumed that the duty of the state was limited in the ideal government to protecting its citizens against external aggression, and to securing them justice among themselves. As regards the latter point, the complaints which then arose were directed mainly against certain artificial restrictions on trade and industry. Under these conditions it was assumed, fairly enough, that the duties of the state were largely negative, and that the mere removal of artificial barriers would permit normal development by the individual. It was not recognized that in the growing industrialism there was a power at least as forceful as in the militarism which had apparently passed away; and that against this new power the individual would be relatively defenseless. As is usual with the gradual development of great movements, the world has come to recognize these things long after the event. To the men of 1820, individualism seemed clearly indicated as the only sound line of development; by the time their theories had become generally accepted, the possibility of any true individualism had gone by.

What we have to deal with now are not the conditions of 1820, but a vastly different state of things; and what we have to consider is how these changes in conditions, and the probabilities as to future developments, are to be met. We may talk as much as we please about the advantages of individualism, of free competition, of personal ownership, and of freedom from state control. Such talk will

do no harm so long as we appraise it correctly as a merely theoretical admiration for certain conditions which once were possible. But as soon as we come to deal with existing facts, we find that this general admiration can not be translated into action. The purely individualistic program is now impossible of execution, and the theory which underlay it will in time become of merely historic interest. As it passes from the field it leaves revealed certain conditions and ideas which do require consideration.

The Program of Socialism. The practical defects of the individualistic theory became obvious enough long ago, and the first sharp reaction from it nationally took place in the opposite direction of collectivism or socialism. This gained strength and definiteness first in France and Germany, where the burdens of the new industrial conditions were heavier than in England or America; but its growth has been steady and far more rapid than is commonly supposed. Its opponents are too apt to overlook the fact that socialist propaganda has an immense moral strength, appealing in striking form to the better sentiments of human nature. Its weakness, indeed, is not ethical but practical; for it offers very doubtful remedies for very actual wrongs. It can not be effectively combated by denial that the wrongs exist, but it might be met by the argument that there are better ways in which they may be removed.

It is difficult to summarize adequately, in a few sentences, the cardinal doctrines and promises of socialism; for there are wide differences of opinion among socialists themselves on many points. Even casual observation will suggest that the milk-and-water socialism of intellectual society can hardly be the same doctrine that inspires the syndicalist movement and its accompanying outrages. But there are certain ideas which seem to be held in common by all who consider themselves socialists, and the more important and striking of these generally accepted theories and hopes may be briefly stated to advantage in the present connection.

The basal complaint of the socialist is that the existing private ownership of capital, land and other means of production is absolutely and wholly unjust, inequitable, and without either ethical or historical warrant. With certain parts of this statement many intelligent people may agree; from others they may dissent just as sharply. From the socialist standpoint, however, the abolition of private ownership of such types of property is essential to a sound and equitable condition of society. As to whether there is to be compensation to existing owners, there appears to be a wide difference of opinion among socialists themselves. As to the mode of acquiring the property, that too is subject to great differences of opinion. The syndicalists believe that private ownership may be made so unpleasant, unsafe and unprofitable as to be abandoned, more or less voluntarily; others appear to favor taxing it into collective control.

After collective ownership has been established, the socialist program becomes more vague, for the real defect of socialistic theory is that it has not ventured on any constructive ideas. We are encouraged to believe that the mass of the population will work hard enough to keep the world going; that there will be more leisure for everyone, and a far more equitable distribution of gains; and that it will be possible to keep this collective state in motion without serious force.

The opponents of socialism may be divided into two classes. One group spends its time in shrieking that the abolition of private property is wicked — and seems to expect this plea to end the matter. But most of those who oppose the socialistic program do so on the grounds that it does not promise an effective mechanism for operating a modern industrial state; and that there are other and preferable ways for redressing the wrongs of which socialists complain. It seems clear enough, at any rate, that socialism can not be adopted by any single country, and that

it can not be adopted by the civilized nations until all the world is brought up to substantially the same stage of culture, both mental and ethical. For, whatever may be its other advantages, a socialistic state will not be strong as against external aggression; and until the possibilities of such aggression have entirely disappeared the acceptance of socialism by a single nation would simply mean national suicide.

It is easy to state, and perhaps to over-state, the difficulties which would have to be faced if a purely socialistic state were to be kept in operation. It must be understood, however, that in the present condition of society unrestrained individualism would bring about still more serious difficulties. As a mean between these two extremes, all modern nations have adopted, to a greater or lesser degree some policy of state regulation.

The growth of regulation. Along certain lines progress has been made to a degree which is recognized as astonishing, when compared with quite recent conditions. To-day, for example, no one seriously argues that the state has no right to offer the possibility of free education to all children; but only a quarter century ago this was still held to be an infringement of private liberty by the English individualists. To-day no one seriously maintains that the state has no right to prevent the spread of contagious diseases, yet within the recent past this too was looked upon as a trespass on the rights of the individual. And there are very many other instances of similar type where the right of the state to protect its citizens by direct regulation of certain of their actions is universally admitted. In a very important class of cases, therefore, state intervention has become commonly accepted, and the claims of individualism have been tacitly relinquished.

In another very large class of cases, however, dealing with labor conditions there are still wide differences of opinion and practice; for thanks to our federal system we

have some fifty different possibilities in the way of legislative enactment and judicial interpretation. Those who oppose state intervention in such matters on broad constitutional grounds rarely realize that the basis of their reasoning is somewhat antiquated, and that the arguments against state regulation of working hours are essentially the same arguments which were originally brought forward in opposition to quarantine regulations, to compulsory vaccination, and to free schools. The theories of 1820 may still persist in some quarters, but the actual practice is gradually conforming to existing industrial conditions. We know, for example, that at present there is no real legal warrant for forcible government intervention in a labor dispute; but we also know that even a very conservative administration would find a prompt solution of that difficulty in case there was imminent danger that the fuel supply would be cut off during a hard winter. What it all amounts to is that political theory has again lagged behind industrial progress; and that in order to prevent an absolute breakdown of the state machinery we have to meet each new contingency with a temporary, makeshift, and often illegal remedy. It is the contention of the progressive parties and schools of all the world that the time has come to bring political theory into conformity with existing facts; to recognize frankly that new conditions have developed during the past century; and to meet these new conditions in a legal and equitable way, by offering a program which will be in accord with the conditions and ideals of the present day. Conservatism is an admirable quality, but if persisted in past a certain point it becomes more dangerous than radicalism; and adherence to an outworn convention is more disloyal than its abandonment. The " one hoss shay " was a worthy object of affectionate regard; but that regard would have been badly evidenced if its owner had maintained that it was fit for use as a passenger coach behind a modern locomotive. In the same manner we may look back with respect to the theories

and institutions of our ancestors, but we are not justified in assuming that they are necessarily adapted to present use.

The divergence between inherited theory and existing fact becomes most noticeable when we consider the problems raised by the rapid industrial development of the past half-century, and particularly of the past decade or two. When American industrial conditions of the present day are compared with those of even twenty years ago, great changes will be noted, on both sides of the account. On the one hand are the increase in average size of the business unit, the extent to which many industries have become integrated, the development and concentration of credit facilities, and the growing differentiation between actual ownership and the immediate management of the business. On the other hand, we have a working population increased largely in number, and changed greatly in type; the exhaustion of the free land in the west, which formerly acted as a balance wheel against low wages; and the growing strength and changing ideals of the labor unions. Out of these changed conditions has come an increased public interest in all questions concerning either wages or prices, and the need for at least a tentative program for meeting the problems offered by the new industrialism.

In facing these problems it must be borne in mind that in addition to the general difficulties presented, common to all the industrial nations, there are others which are peculiar to the United States. This is due to the complex nature of our federal government. The existence of the numerous state governments offers, it is true, great flexibility in the way of experimental and local legislation; but on the other hand it presents a series of written constitutions, most of which were prepared during a period when individualism was the prevailing theory. With the added development that the courts are now held as superior to the legislature,

it can be seen that progress is necessarily slow. Even at this day, in opposing proposed new legislation, it is more effective to say that it is unconstitutional, than that it is unjust. This difficulty arises in each of the states; and in attempting a broader treatment of any subject the difficulty is augmented by the constitutional limitations which were originally put upon the Federal power. Because of these conditions there is peculiar need for care that the progress in economic and industrial legislation should take such form as to meet general conditions, and not merely remedy specific instances of injustice; that it should be clearly defined in trend, and not merely opportunistic; and that, while retaining touch with present conditions, it should aid directly in the improvement of such conditions and not merely accept them as necessarily final. Our civilization is still in course of evolution, and government must not only be put into conformity with the present stage of growth, but must be given such freedom for future development that its agencies will not be repressive, but inspiring. In doing this, while the extreme individualistic standpoint of the past may be abandoned, it will still be possible to utilize individual effort to the utmost extent.

The form and sphere of the State. It can be seen that, in the three great modern industrial nations, the tendency from 1880 to 1914 was in substantially the same direction. There are differences, it is true, between the former imperial paternalism of Germany, the liberalism of England, and the progressivism of the United States — but these differences are due to local conditions, and relate to points which are essentially of minor importance. On the other hand, the three policies named agree in two points which are of absolutely fundamental importance. First, they are based upon the maintenance of the institution of private property, holding that through it the maximum amount of welfare and prosperity can be assured; and in this point they differ

from socialism. Second, they are based upon the regulation by the state of such private activities as affect the welfare of the citizen; and in this point they differ from the old individualism.

Assuming therefore that there was substantial agreement in fundamentals between German paternalism, British liberalism and American progressivism, it is of interest to attempt to roughly outline the type of state toward which these policies tend, and the sphere which state activities are likely to occupy. In doing this it is possible to frame the statement in a perfectly general way, so that it applies as aptly to one as to another of the modern industrial nations.

The modern industrial state is a highly complex organism, made up of citizens varying greatly in their natural characteristics, their ability, and their immediate interests. But under modern conditions this mass of citizens is knit together so closely by various ties that no healthy development of the state can occur while any class or group of its citizens is subject to injustice, or to handicaps of any sort which can possibily be removed. The state must, in self protection, offer not only defense against external aggression, but it must also offer absolute justice and equity within its limits. Further than this, it must aid in the moral, mental and physical development of the individual citizen, not for his sake alone, but because the state organism can not develop rationally unless it be composed of normally developed units. Still further, since the various productive industries are the ultimate bases of our existing civilization, the state must insure that they are carried out, in all of their stages, with fairness to all of the classes involved in the process. Finally, since the support of the state is derived necessarily from taxation, the basis of taxation should be so adjusted as to be proportionate to the benefits derived from the state by the taxpayer. And in carrying out the state activities necessitated by this program, the details must be so planned as to involve the minimum of administrative expense and

state interference with private effort, consistent with securing the desired results.

In the program thus summarized there is nothing inherently revolutionary, for all of the elements contained in it have been accepted, at one time or another, by political parties of very conservative type; and it is not in any sense socialistic, but is the very antithesis of socialism. It is, in fact, merely the statement of the policy which must be adopted if we are to avoid a purely socialistic régime.

It must be noted, furthermore, that nothing is necessarily implied as to the form which may be taken by the state administration. It might be an absolute monarchy, as until recently in Germany; a government by Parliamentary majority, as in Great Britain; or a government by legislative majority subject to court interpretation of written constitutions, as in the United States. Each of these types has its own special advantages and disadvantages; but in the long run all of them seem to have been fairly responsive to the necessities of the case. The British government, lacking any actual control by the House of Lords, is at present the most immediately responsive to waves of popular sentiment; while the American government, with its written constitutions, is least so. Until we are willing to believe that every temporary shift in public feeling should be immediately registered in new legislation, this condition is not entirely to be regretted.

The development of theory. As a convenience in comparing the chronologic relation between theory and practice, the following table has been prepared. It contains, by order of date, a list of the principal books which have exercised any important influence upon the development of either industrial or political theory during the century and a half covered by our modern industrialism.

1774. Smith, *Wealth of Nations*
1798. Malthus, *Principles of Population*

1817. Ricardo, *Principles of Political Economy*
1839. Comte, *Philosophie Positive*
1848. Mill, *Principles of Political Economy*
1855. Spencer, *Social Statics*
1859. Darwin, *Origin of Species*
1865. Jevons, *The Coal Question*
1867. Marx, *Das Kapital*
1897. Sorel, *Socialist Future of Trades Unions*
1908. Sorel, *Reflexions sur la Violence*

The series above noted, beginning in the strictest individualistic teachings, runs through a modified individualism, the beginnings of the natural evolutionary teaching, to Marxian socialism and finally to current syndicalism.

The leadership of minorities. In a popular government, under universal suffrage, we are apt to talk easily enough about the rule of the majority. But as a matter of fact, except at very rare times, the rule actually exercised is that of a small but alert and active minority. This is true not only of government, but of all other assemblages of human beings, for in every case the vast majority of the assemblage will under ordinary circumstances exercise little if any effect on the action of the group. What we find commonly is two small opposing groups, perhaps not making up together over ten per cent. of the whole, but each with definite ideas which it is willing to attempt to carry out, and to whose furtherance it is willing to devote steady organized effort. The continuous struggle, for each of these small groups, is to obtain the support, active or implied, of the large majority, so as to have a sanction for its plans and actions. The large mass which thus sways uneasily from one side to the other is made up in varying proportions of those who are too uninterested, too stupid, too lazy or too unorganized to do more than follow a good lead. When, on very rare occasions, a crisis arises which strikes so deeply as to cause the majority to think and act for itself, the results are apt

to be important and sometimes surprising. But, during ordinary times, we can assume that any small group with a definite plan, willing to work hard enough to secure its accomplishment, can carry it through.

What is true of political rule, is also true of political ideas and of mental progress in general. A new idea or theory, whether scientific, political or industrial, is developed and enunciated by one man; it later forms the rallying point for a group. It may finally be accepted by all, but when that time comes it is wise to scrutinize it very carefully, for circumstances have probably changed sufficiently to cause it to lose its original validity.

Perhaps the best instance, and one fortunately free from possibility of present day prejudice, is afforded by the manner in which popular ideas as to natural evolution in general and modes of evolution in particular struggled on, a decade or so behind scientific leadership. When Darwin's epoch-making work was given to the world, his clerical and other opponents countered by arguing against the ideas of Lamarck; by the time so-called " Darwinism " had become a common-place of popular thought, scientific thought had frankly abandoned some of his ideas as to modes of evolution, and had made advance in another direction. The drag or delay in popular acceptance of a new scientific or technical idea is indeed so great that it is almost safe to assume invariably that any idea or theory which is currently accepted is probably wrong or obsolete.

It may be said that acceptance of the ideas set forth in the preceding paragraphs necessarily implies disbelief in democracy and in its modern mode of expression, universal suffrage. But that does not follow, for whatever may be thought as to the inherent difficulties in the way of operating a thoroughly democratic government so as to secure rational and ordered progress, there are still greater difficulties immediately obvious with regard to any other possible type of government. We have just witnessed the hopeless moral

collapse, followed by the complete material failure, of the most serious and promising attempt that the world has ever seen in the line of industrial paternalism carried out under a monarchy. The moral bankruptcy of German autocracy does not encourage further attempts in that direction.

The truth seems to be, that any group which attains power, under any form of government, tends to become reactionary, arbitrary and oppressive. It has reached this position of power because it had an idea or theory which, at that moment, was of value to the state. But as time goes on the ruling group loses its freshness of viewpoint, and its possibility of progress. Further development must come from its opponents. The problem of government is to secure a method for weighing new ideas and theories, and for adopting those which seem to promise improvement. The problem of the people is to find peaceful means for replacing political groups which have become fossilized. Democratic government, with all its obvious difficulties and defects, makes it possible to do this with less friction than in any other type of government available.

So we may as well set aside all vague yearnings for paternalistic industrialism under the rule of kindly kings, or even scientific management under the advice of self-nominated experts, and accept the fact that future progress in the great industrial nations will be under an increasingly democratic rule. And what will save and justify democracy in the long run is the fact that the very responsibilities thrown on the mass of the people do, as time goes on, develop characters and abilities to support these responsibilities.

The question of class rule. In all modern countries the spread of industrialism has operated to bring about sharper lines of definition between certain great classes of the community, whose ideals and desires, at any given moment, may be sharply opposed. This condition is admitted, but

most of us do not believe that it is so serious that society must be wrecked in order to change it.

The weakness of the radical attack arises from the fact that there is not an important country to-day in which the real class distinction is between Capital and Labor. There are very real class differences, but the possession of money is not the sharpest ground of distinction. The classes tend to separate along other lines of cleavage, brought about by their life-long training and habits.

What we really have to deal with in most countries are three large groups. One of these owns or works agricultural land; one is interested in trade and commerce; and one supplies transport and factory labor. When a radical speaks of Labor with a capital L, he refers solely to this last class, and he disregards the facts that members of the other two classes really work, and that his specific Labor group makes up a minority of the population in practically every country. If we take the United States, France and Germany as three representative countries, and average the results, it is probable that the three groups named would be approximately equal in numbers, each making up around a third of the employed population. Great Britain, owing to the present small development of agriculture, is much more poorly balanced in this respect, and this fact has important effects upon her political development. But for the other three countries, and indeed for most of the other nations of the globe, we may fairly assume that the distinctively Labor group nowhere represents more than a strong minority.

A balance of power of this sort does not promise much in the way of very radical re-adjustment of society, but on the other hand it offers a very fair guarantee that no one of the groups is likely to suffer from scandalous ill treatment. If any reform becomes urgently and obviously necessary, it is always brought about by temporary coalition of two of the

groups. The underlying differences in requirements are so great that the coalition is never permanent. All of our fiscal and commercial policies, from the beginnings of the Republic to the present day have been carried out by groupings of this temporary sort; and it is probable that our industrial policies of the future will be handled in similar fashion. Until the time comes that external economic pressure is so great that it seriously interferes with the well being of all three classes, we are not likely to see any very serious results from radical propaganda in the United States, or even in the more important European states.

CHAPTER XXIII

THE TREND AND RATE OF FUTURE GROWTH

In an earlier chapter, when the causes of industrial development were under consideration, certain factors which tended to fix the rate of such growth were noted and discussed. The question then at issue was as to the rate which industrial growth had shown during the past century or more, and for that purpose a general average over that period was sufficient. We may now take up the figures then used, and examine them from a somewhat different standpoint, in order to get some idea as to what they indicate with regard to future developments.

Primarily, it may again be suggested that the phenomenon of rapid growth, to which the world became so accustomed during the period 1770-1910, was not one which had always existed, or which must always exist in future. As to the first of these statements, we have of course ample data available for proving that in all the centuries prior to the Industrial Revolution there was an entirely different condition existing, with regard to both population and industry, than has been shown during the past century and a half. Nowadays we think that a year which should fail to show an increase in population or in commodity output is something remarkable, which requires explanation. But throughout very many centuries there were not only single years, but decades and full centuries which were marked by just such conditions of entire lack of growth.

Even at its most favorable, the rate of increase prior to 1750 or thereabout was very low, which is indicated for one thing by the population statistics relative to England, whose protected position certainly was favorable to growth rather greater than that of continental Europe. We know, on the

basis of more or less close estimates made for various purposes, that the population of England grew about as follows during the centuries noted:

Year	*Population England and Wales*	*Per cent. increase per century*
1100	1,800,000	..
1400	2,500,000	11
1600	5,000,000	40
1700	5,500,000	10
1750	6,500,000	45
1800	8,900,000	70
1851	17,900,000	200
1901	32,500,000	170

From this table, where the percentages of increase per century have been added with as much precision as the matter is worth, we can see very clearly that in place of a growth of population at a modern high rate, there was in reality a very low average rate of increase for many of the centuries of English history. Further, it is made clear that in place of steady growth there were really several very abrupt changes in rate. We might fairly say that the ordinary rate of growth of English population was not over ten per cent. a century; but that during two periods of about one hundred years each this rate of growth was very largely exceeded. One of these periods was that, from 1500 to 1600, which was marked all over Europe by the trade activity brought on by the American discoveries, a fact which we have already come across in discussing the effects of gold discoveries on prices. The second period of exceptional growth was that beginning in the eighteenth century and lasting until now. It was the period affected by modern industrialism.

We see, therefore, that the rate of population increase has not always been as high as that to which we have grown accustomed. But we see also that once before, during the Elizabethan period, an unprecedently high rate of increase

did take place, and that this did not endure, but was followed by a falling back to the old low rate of growth. This is of particular interest to our present inquiry, because it implies that a similar retrograde movement may be repeated in the future. It will be of interest to examine the available data more closely than has been yet attempted, in order to see if they suggest any such possibility as imminent.

For this purpose we can make use of the tables of American and world population already used on page 188 of this volume. The calculated percentages of increase per decade, as shown there, seem to indicate a quite definite downward trend in rate, which is brought out much more strikingly when it is placed in diagrammatic form, as in figure 9, below.

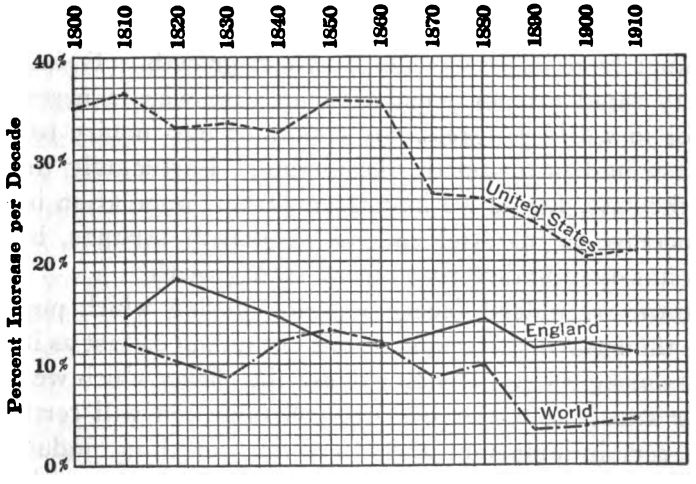

FIG. 9. Rate of population increase, 1800–1910

In this figure we have used three sets of data, relating respectively to the population growth of the United States, of England, and of the world. The two former are based on exact figures; the last is based, of course, in large part on estimates and may therefore be given somewhat less weight. But as a matter of fact all three of the sets of

results show the same tendency toward a lowering rate of increase. This was first shown by the United States in 1870, when even after correction of the earlier incorrect census figures there was a very startling drop in rate of increase as compared with anything that had been previously shown by America. The English rate reached its maximum in the decade 1810-1820, and has fallen irregularly since, its last downward swing having taken place around 1890. The world figures when a fall in rate from around 1850, which became still more marked around 1890.

With these facts in mind, and having regard to the certainty that the various censuses to be taken in 1920 will necessarily show very trifling rates of population increase in all of the warring European nations, we are forced to accept the conclusion that one very important factor in our modern civilization is apparently now in process of showing a change from its previous high rate of growth. If, indeed, a very rapid rate of population increase were a necessary factor in world progress, the results of our inquiry to this point would be distinctly disquieting. Fortunately this is not the case, for as we have seen earlier, population is apt to increase as material and social growth expands, but it does not operate directly to incite such growth.

If we are indeed facing a period during which population, though still increasing, is not expanding as fast as it has done during the past century or so, the effects which we may fairly expect to accompany this phenomenon will certainly have certain important and interesting social and industrial effects. Primarily, for example, it would seem to imply that there will be possible a relatively higher average standard of living and of general comfort than would be possible under other conditions, and than has been possible at any time in the past. There should also be a tendency toward lessened friction between classes within the nations; and if the fall in rate extends to all peoples alike, lessened reason for friction between the nations. This last qualification is

of high importance, for obviously a differential rate of population increase, bearing heavily against the white races alone, would in the long run be a serious matter.

Effects on industry. In its more direct bearing on the future of industrial development, a falling off in the rate at which population has heretofore increased would obviously act to cause differences in rate of growth of two classes of industries, according as they are or are not *directly* related to population. All the industries whose products are increased in demand only as population increases would be less rapidly developed in future than in the past, and less rapidly developed than the other and larger class of industries in which demand does not vary directly with population. In practice this would mean that there would be *relatively* less pressure than heretofore against the food supply, a condition which would be desirable from every point of view. We might hope that in the years to come our future improvements in transport and agriculture would at last more than keep pace with increased demand.

As for the mass of the manufacturing industries, the differentiation between them would take place along the same lines. Such industries as made articles of limited personal use would in future grow less rapidly than those which made articles whose per capita utilization can be largely increased. On the other hand, the objects used by communities are limited in demand by the wealth available for their purchase, rather than by the number of people whom they will serve. And if in future wealth increases much faster than population we may expect to see very remarkable examples of its employment for civic and national uses.

We may go further, and suggest that there is likely to be a much more rapid rate of increase in highly finished products, both old and new, than there will be in the heavy staples. This condition would affect the future rate of growth of the iron industry, and to a lesser extent that of coal mining; and in each of these cases it might be expected

to bear most seriously upon the more primitive utilizations of the two products. That is to say, in future we may expect to see a less proportion of the coal used for mere hauling of goods, and a larger proportion for making goods; and of the iron less will go into ships and more into finished articles.

The effects on iron. In earlier discussion of the duration of the world's supply of iron ores, it was noted that the pessimistic conclusions often reached depended, in the last analysis upon the assumption that the demand for iron would increase at a very high rate each decade. It was suggested that this assumed rate of future increase might not actually be attained, which of course would remove all reasonable fear of exhaustion of our ore supplies. Now this suggestion was not based upon our present idea that population may not increase in future as rapidly as it has in the past, but upon an entirely independent and more direct line of evidence. For when we come to examine the actual records over recent decades we find that there seems to be indeed some reason to expect a comparatively imminent falling off in the rate of increase. Writing early in 1914 [1], before the World War had come to complicate matters, it was possible to summarize conditions as they then appeared as follows:

> Though iron and steel are not imperishable, the amount which is lost to the world each year is a mere fraction of the annual supply, and this fraction is becoming relatively smaller each year. The chief loss is by rusting, though the more spectacular losses to which attention is called are through shipwrecks, mine disasters, etc. As the world goes on we may fairly expect that both these sources of loss will decrease, at least relatively to the total supply. But this implies that the bulk of the year's output is added to a steadily increasing stock of iron and steel already in use; and obviously there must come a time when the stock on hand will be sufficient for all uses,

[1] Eckel, E. C. "Iron Ores," page 407. New York, 1914.

with the help of comparatively slight additions and renewals. This may be accepted as a certainty of the future; and the only question then is, whether the slacking off in demand is likely to occur soon or at an indefinitely future day. Of course this question can not be answered with any precision, but even a summary of the main facts bearing on it brings out some points of interest.

If we could confine attention to Europe and the United States, it could be said that both the annual output and the consumption have shown steady and large increases for many years; but that in spite of this fact there are certain features indicating that the turning point may be nearer than expected. There must be noted, for example, that in certain lines the industry is not progressing as fast as heretofore; the rail-mill capacity of the United States, as an instance, is probably almost twice as great as the average annual requirements. And there is the far more important fact that the great producing nations have, during the past decade, been led to depend more and more upon the export trade, not only during years of depression at home, but during normal years. It is indeed very doubtful if the civilized portion of the world, confined to its own markets, could hold the 50 per cent. rate of increase for more than a decade longer.

But the outlook becomes more encouraging when the other parts of the world are recalled to mind. At present European and American mills supply the iron and steel requirements of a civilized area which contains about one-third of the inhabitants of the globe. At first glance it might be assumed that the sudden modernization of the world would afford a market for about three times our present annual steel production. This, however, would be an error of the same type which is encountered when the western United States is compared, for example, as a possible steel or cement market, with the east or middle west, on a purely population basis. Steel consumption is not entirely dependent on population; and large portions of the earth's surface will never be as important consumers as Europe. If we had any exact data on the coal reserves of the world they might serve as a better basis of comparison than population. But since exactness is not required in the present

> discussion, it might perhaps be safely assumed that if the entire world could be suddenly modernized up to the standard of Europe and the United States, a market for between 125 and 175 million tons of steel per year could be found now.
>
> This is somewhat more than double the present output of the world; but it is only about what the present rate of growth will produce by 1930. So that even on this basis, two decades more may see the beginning of a decreased rate of growth in the steel industry of the world.

The preceding statement has been quoted exactly, in place of re-writing, in order to place on record the standpoint of pre-war days, which is free from the influences which might be assumed to affect a later judgment. But as a matter of fact, the war has strengthened these conclusions, rather than weakened them. In place of waiting until 1930 for the first marked decease in rate of output, we will see it, unless all present business signs fail, when we come to compare the world figures for 1920 with those of 1910. At the old established rate of increase the world, having made 65 million tons of pig-iron in 1910, would be expected to make some 100 million tons in 1920. This seems to-day a hopelessly impossible task. We can go even further. The lowest rate of increase of the world's iron industry, in any decade since 1800, was the 33 per cent. shown by 1810-1820, which was affected by the past Napoleonic war depression. If we drop even to this low level of increase, the world should produce at least 86 million tons of pig-iron in 1920. It will be interesting to see what the figures do actually show at the end of 1920, for it begins to look as if we should make a new low record in rate of increase, as compared with anything experienced since 1800.

The record of coal and iron. It might be noted that somewhat the same general tendencies are exhibited when we come to examine the record of coal production during the past century, and to compare the rates of increase which it

has shown in successive decades. In the following table such comparisons are made for both the coal and iron output of the world for the period between 1800 and 1910.

Decade Ending	*World coal output, per cent. of increase*	*World iron output, per cent. of increase*
1810	24	38
1820	19	33
1830	45	83
1840	78	71
1850	82	57
1860	75	72
1870	50	77
1880	54	52
1890	55	49
1900	50	46
1910	51	62

In both industries the greatest sustained rate of advance, during their entire history, was shown during two periods. One of these, not shown in the above table, extended from around 1770 to about 1810, and covered the time of the so-called Industrial Revolution in England. The other and more important extended from around 1825 to 1865; it developed from the long depression which followed the Napoleonic wars, and covered the periods during which Germany and the United States laid the foundations of their great industrial development.

Since the close of this last-mentioned period of rapid growth, though both coal and iron output have of course shown large increases, neither industry seems to indicate a return to that very exceptional rate of growth. Both seem to have settled down to a much slower rate, and in bad times to fall below even this recent average. The great increases in rate of growth, during our later boom periods, have been exhibited more markedly by many other products than by coal and iron, as we seen when we noted the growth, during recent decades, of the newer metals and

chemical products. That is, indeed the direction in which the greatest future progress is likely to be shown, for we seem to be merely on the threshold of the development of alloys and chemical products.

The fall of prices. Without regard to its effect on population increase, the World War had certain very definite and obvious effects on industry and trade. There was a tremendous demand for certain lines of products, regardless of price; there was a heavy increase in governmental indebtedness; and there was a rise in prices which can only be compared to the similar rise caused during the Napoleonic wars. This rise was caused almost entirely by the vast government expenditures, carried out by use of a highly inflated currency. Beginning in foods and munitions, the rise spread gradually into all other commodities. Beginning in the warring nations and in markets from which they drew their supplies, it spread finally all over the world. Among its earlier effects were great rises in wages; among its later, very widespread labor unrest. Financially, it expressed itself in a phenomenal rise in interest rates, so that even entirely peaceful and stable governments are now paying double the rate which would have been necessary ten years ago.

The conditions which now exist, in respect to prices, interest rates and social unrest are essentially temporary; and unless some entirely new factor intervenes we may reasonably expect to see them changed very soon. The heaviest of the government expenditures are completed, and a period of relative economy will arrive in all countries. The inflated currencies will be deflated as painlessly as possible, and as government finance approaches sanity, prices will fall steadily and irresistibly. With their fall, since wages do not fall as rapidly, there will be a long period during which social conditions will be easier for the average citizen, wage-earner or not. And there will ultimately be a corresponding decrease in average interest rates. If the ex-

periences of the Napoleonic wars are repeated, we may fairly expect to see sound governments able to refund loans at three per cent. or so within a decade of the end of the World War.

The new impetus. We have seen that, at the commencement of the World War, industries and prices seemed to have reached and indeed passed over a temporary high point, and to be started on a slight decline. The war interrupted this process, and changed its result. What we have now to face is a different condition, in which the war-effects will have more weight than any normal trade factors.

We can assume that the fall in prices and interest rates, together with increased government and private economy, will operate to deflate a number of unsound industries all over the world. This of itself will not be a bad thing for the world, for falling prices do not necessarily mean danger to either labor or capital, so long as they do not arise from decreased demand. Even if prices and profits per ton fall off, the total profits of an industry may increase provided more tons of the product can be marketed. So that the long period of lowering prices, due to currency deflation, to which we look forward does not necessarily imply industrial depression.

On the other hand, a period of world-wide trade activity, such as came about around 1825, 1845 and 1898, may be expected to come whenever a sufficient inciting cause is set in operation. This cause will probably be the commencement of intensified development in one of the three backward continents, and there are some reasons for believing that it will take place in Africa, rather than in Asia or South America.

All of the changes which have been noted above as likely to follow from conditions now existing may be accelerated or retarded by the introduction of new factors, and some of the more important of these possible factors may now

be taken up in the idea of determining their probable influence and extent. So in the following chapters we will consider the question of world competition in general, and of the competition likely to be offered by new or re-awakened nations in particular, so far as these matters are likely to bear upon our own industrial or social conditions. And in a still later chapter we will consider the question of war, which would operate to prevent a fall in prices and in interest rates, just as the overwhelming competition of a new industrial nation might operate to accelerate these changes and make them serious. For though falling prices in themselves are an advantage to most of the community, falling prices accompanied by unemployment, due to restriction of the market, are far from advantageous to anyone. It will therefore be profitable to go on to consideration of world competition and of war, and to see whether or not there is any necessary relation between them.

CHAPTER XXIV

THE FACTORS OF WORLD COMPETITION

Emerging from a war which has left the civilized world very poor indeed, we must prepare to go on into a trade competition which will assume sharper forms than it has ever done in the past, since the necessities of the sellers are greater, in the case of manufactured products, than are those of the buyers of such products. This condition has arisen because of the war. It would not exist if all the countries of the world had suffered equally by that war. Unfortunately this was not the case; the losses in real wealth — men and commodities — fell upon the white race almost exclusively, and in reality upon two particular branches of that race. Further than that, the war acted as a selective agency in destroying manhood of the leading industrial countries, for of the great world competitors of 1913 only Japan escaped entirely unscathed. As a result, it might be said broadly that the manufacturing countries are left poor; the countries which produce food and other raw materials are enriched relatively.

But even within the industrial group of nations the losses are not equally divided. Japan, as noted, is not impoverished but enriched on balance; the United States has lost relatively little; but Germany, France and Great Britain have contributed too heavily in lives to emerge unshaken. Later we may recur to some of these matters, in an effort to estimate the future relative importance, from competitive standpoints, of these different countries. But at present we may merely accept the fact that the losses have in all cases been severe, and that in order to re-adjust the financial position the export trade will receive even more attention than heretofore from all the great manufacturing nations.

The rise of foreign trade. Regardless of the effects of protective tariffs, a growing industry through its early stages finds all of its activities necessary in its struggle to secure a firm footing in its home market. At a later stage, provided the industry is firmly grounded so far as raw materials and other manufacturing conditions are concerned, it will reach the point where it substantially dominates its home market, into which foreign manufacturers will be able to ship only during periods of very high local prices. At a still later stage of its development, the industry will find that, first in years of bad business at home, and later in all years, it will have a surplus manufacturing capacity, which it can either shut down unprofitably, or use to provide a surplus tonnage of its product, which can be shipped to a foreign market. All of this is an entirely natural development, and occurs in about this order in all of our larger industries, so far as these have been based on good natural resources. We are usually proud of the export trade thus developed, but at times some of its necessary features give rise to misunderstanding and consequent criticism. Since the United States will in future be forced to engage more heavily in export business than it has in pre-war times, it will be well to see how these misunderstandings arise. The export trade has enough troubles of its own without having constant investigations or prosecutions.

In order that any country may steadily and profitably export any manufactured commodity, there are two essential requisites. The commodity must be produced more cheaply in the exporting country than in the market country, even after allowing for freights to the market; and there must be a surplus tonnage of such commodity, or surplus producing capacity, in excess of domestic requirements. The first condition implies that the exporting country must have natural advantages with regard to certain factors in production — it must have good and abundant raw materials, satisfactory labor supply, cheap capital, or other advantages

of these types. The second condition implies that the industry in question has been, either accidentally or intentionally, overbuilt beyond the average requirements of the domestic market. As a matter of fact the overbuilding is usually accidental, not intentional, and the fact that it exists is only realized when hard times set in at home. It is then found that the domestic market will not absorb all the product that can be made, and the two alternatives faced by the manufacturer are to partly shut down his mills or to attempt to find a foreign market for the surplus. Reduction of output means decrease in the labor employed and usually an increase in the manufacturing cost per ton of finished product, because much of the overhead charges run on regardless of whether the mill is running full or not. Exporting the surplus product enables the manufacturer to avoid both of these difficulties.

It has been said that the first export of any manufactured commodity usually occurs during a time of business depression at home. The exports then made are not taken up with any idea of securing abnormal or even reasonable profits, but simply in order to relieve the home situation. Under these conditions export sales can be made at any price above actual manufacturing cost; and the price may be varied from point to point in order to meet competition effectively. The prime requisite is to sell sufficient goods to keep the mills running at their point of maximum efficiency and minimum cost per ton.

This first experiment in the export trade is commonly followed by prompt withdrawal from it as soon as home business begins to improve. For ten or twenty years American steel producers, for example, made sporadic efforts to export during times of bad business at home, dropping the foreign trade as soon as the home demand resumed. But later in the history of an industry it is seen that an export trade can not be played with in this fashion, if it is ever to amount to anything. If the foreign market is

to be useful in bad times it can not be entirely abandoned during good years; and when this is understood the export business, in any given line, assumes a more steady and continuous form.

The practice of dumping. A steady and continuous export trade, however, implies that in periods when trade is good at home but depressed abroad, which often happens, representation in foreign markets can be retained only by selling some portion of the tonnage at prices below the domestic level. This practice, which is known as " dumping," is subjected to severe and largely unmerited criticism by those who do not understand its origin and its merits. When it is carried out the home consumer pays for his commodity the same price he would pay in any case; the foreign consumer pays whatever price is necessary to meet local competition. The home market receives, in addition to the commodity, the stimulus of active mills and fully employed labor. The foreign consumer receives a commodity at perhaps too low a price. The foreign competitor receives — competition.

There is of course an entirely different phase of the dumping question, one which has been forced on the world's attention of late years by complaints against German practices, but of which our own first experience came from England at the close of the War of 1812. It will be recalled that the industries of the United States had expanded greatly, though only temporarily as it later proved, under the forcing effects of that war and of the embargo which had preceded it. This was naturally viewed with concern by British manufacturers and statesmen, and the result was an attempt to break down the new industries after the peace by heavy shipments of goods to be sold at any price. The oft-quoted Parliament speech of Brougham dates from this period: " It is even worth while to incur a loss upon the first exportations, in order by the glut to stifle in the cradle these rising manufactures in the United States, which the

war has forced into existence, contrary to the natural order of things." That utterance, so useful in later days for American protectionist orators, summarizes very clearly the phase of dumping to which all nations naturally object, when practised on themselves, and against which most modern tariff laws provide a remedy in the shape of some anti-dumping clause.

Of both these phases of dumping we are likely to hear even more in the years to come, under conditions of intensified competition. Our own people will complain that we are selling goods abroad at lower prices than we charge at home, and the foreigner will complain that we are doing it in order to kill his infant industries. And, on the other hand, our manufacturers in some of the newer and less firmly based lines, will certainly have at times unpleasant experiences when the German chemical industries attempt to regain what was once a practical monopoly of the world's markets. It will be in some sense a revival of the happy days when the Standard Oil Company could be hunted simultaneously in Germany and in the United States for the same offense, *both* countries charging that it was selling abroad cheaper than at home.

Factors of export trade. Recurring to the factors which aid in the development of foreign trade, those of most importance may be summarized as follows, so far as they relate to the export of manufactured commodities.

a. An industry must be firmly based, with a good home market, so that the exports do not make up too large a fraction of the total trade. Otherwise we should be in the position of Belgium and Japan, which must export or starve. Of course an industry enjoying a high protective tariff at home has an immense advantage in the export trade, for even the higher wages it will pay do not ordinarily counterbalance its gains in other ways.

b. The industry must have low costs, as compared with its competitors, on at least the fraction of the product which

is exported. To be entirely sound, ample supplies of cheap fuel and raw materials are imperative. A country importing either or both can not make heavy staples for export, though it can, as in the case of France, make and export more highly finished goods. On this account the coal supply of a country is a fair rough index to the position it can ultimately attain in international trade. If the coal supply is large and cheap, it can export manufactured goods for all types; if the coal supply is small, it must export highly finished manufactures; if the coal and labor supplies are both scarce, it can only export natural productions and raw materials.

c. The indirect effect of fuel supply on foreign trade is enormous. Cheap fuel and adequate bunkering facilities mean that there is a positive inducement for even neutral ships to stop at your ports on a long voyage. So long as coal was the only marine fuel, the United States could have readily taken the lead in this matter, though as a matter of fact it has always fallen to the share of Great Britain. With the adoption of fuel oil for marine use, even though this adoption will not go as far as popularly supposed, we will be at a great and increasing disadvantage. The reason for this has been explained in an earlier chapter on petroleum resources, where it is seen that the United States is pretty near the end of its home oil supply. Active measures in the way of securing extra-territorial reserves and good bunkering facilities are necessary if we are to hold any serious fraction of the world's carrying trade.

d. In considering international trade, we must not too firmly fix attention on its selling phase, but must bear in mind that it also necessarily implies buying. To accept gold payments for exports is not economic or profitable for the exporting country, in the long run, though it may be temporarily necessary. It means, for one thing, that your ships are coming back light. Taking securities, whether private or government, in payment for exports should be

regarded as a very exceptional and temporary arrangement, for in the long run it is far more profitable to take instead cargoes of foreign produce. One of the difficulties in the way of establishing cheap trade with South America has arisen from the fact that the export commodities from that continent are somewhat difficult to handle as return freights for manufactured goods.

Foreign exchange. The present chaotic condition of foreign exchange, which must be re-adjusted in some fashion before a *sound* American export trade can be established, arises from the action of three factors, one of which has been just referred to. These are (1) that though there is currency inflation and poor government credit all over the world, the United States is not so badly off as some European countries in these respects, so that there is a real reason why the foreign currencies should exchange at somewhat less than their pre-war ratio. (2) there is actually a large debt owing the United States on balance, for its advances in loans and for excess shipments already made, and the old supply of American securities abroad is pretty well cleaned out, so that it can not be drawn on to repay these advances. The two factors mentioned are serious, and it will take many years to re-adjust the balance in these respects, so that whatever fraction of that fall in exchange is due to their action will remain for some time. The last factor to be mentioned, however, is (3) absence of foreign products to balance our current exports. This arises from industrial disorganization abroad, which can not be expected to continue much longer, and the effects of this particular factor may fairly be expected to disappear in 1920 or 1921 at the latest.

If foreign countries do not have to pay debts or interest on debts already contracted, the existing exchange situation is not seriously to their disadvantage, for it gives them the advantage of a highly protective tariff, ranging from 20 to 80 per cent., directed against the United States only, and

this without creating any unpleasantness. It serves automatically to limit imports of American goods, and to stimulate the sale in America of foreign goods. Extension of credits can act as a palliative of this condition but nothing can remove it until Europe gets back again on a normal producing basis.

Trade expansion. There is an unfortunate tendency noticeable in current discussions of the export question, to ascribe the slow development of American foreign trade, particularly with South America, to the sheer stupidity of American manufacturers and especially to their defective selling methods. This appears to be a very wrong view to take of the case, and it tends to disappear when we consider how foreign trade arises and the factories which are necessary for its development. It seems clear enough that in order to export a product, it must be something which the market country can use, and it must be something which you can make very cheaply, so that you can undersell other foreign competitors. Now a great many of our manufactured products do not fulfill these two conditions, a fact which is often overlooked by enthusiastic consuls. By strenuous efforts we can persuade the Chinese to use kerosene and cigarettes, but you can not easily sell alarm clocks to an Argentine cowboy, or imitation coffee in Rio. These are extreme examples of course, but there are really very many things which are almost as unusable by people who have different ideas of life and comfort from Americans; and this affects a good many of the more highly finished goods which we use here very largely. As to the heavier staples, that is another question. There we come upon the matter of cost of manufacture plus freight, and heretofore Germany and England have been able to undersell us in most lines. The greatest gains in future are still likely to be along the lines in which we have specialized, so as to have distinct selling advantages; such as agricultural machinery, electrical goods, machine tools, etc.

CHAPTER XXV

THE FUTURE OF WORLD COMPETITION

Discussion of the future of world competition, at a time when the peace treaty is as yet unratified, and when many of its future effects can only be surmised, presents very serious difficulties. But if we are right in assuming that national industrial and political development is to a very large extent influenced and limited by national material resources, we may come to certain pretty definite conclusions as to the future course of affairs. In doing this the subject will be taken up under several broad geographic divisions, and no attempt will be made to discuss the countries and regions which are of no present industrial importance, and which give little hope of being of future importance either as producers of manufactured commodities or as markets for such goods. There are some countries which are unfortunate geographic facts, and little else.

The British Empire

The British Empire is still the most important trade factor in the world, though as will be seen later there seems to be reason to expect considerable change in the relative importance of its separate parts.

Great Britain. The industrial development of Great Britain has been discussed at some length in an earlier chapter of this volume, and her recent industrial and political experiences are too well known to need even reference here. What we have to look at are some features of broader importance, as affecting her future trade relations.

We may start from the premise that the commanding international position of Great Britain, in war as in trade, was due to the fact of her large, accessible and cheap coal

supply; and to the further fact that coal came to be used pretty universally as locomotive and marine fuel. Manufacturing was cheaper in England than on the Continent, and trade followed the fuel. The advantages up to around 1880 were unquestionable, and not seriously challenged, in either trade or war. Since that date new factors have entered the problem, and these will be of increasing importance in future.

As matters stand now, Great Britain has still remaining much coal, but it is less accessible and cheap than formerly, while meantime there have been vast coal developments in Germany and the United States.

Coupled with this natural factor, which could not be helped in any way, we have what seems to be generally accepted, in Great Britain as abroad, as being a very serious deterioration in British labor efficiency. This is not a racial question, for the British workman, when he chooses to work, is at least equal to others; and the prevalence of drink is not a reasonably complete explanation. What has happened is apparently a purely social phenomenon, to be cured only by political action, and the leading single cause is perhaps the extreme concentration of land ownership in the British Isles. In Germany, France and the United States over a third of the population is still engaged in agricultural pursuits, and in each case half or over of the population own at least a little land. In Great Britain it has been a long time since as much as ten per cent. of the population were engaged in agriculture, and it is questionable if two per cent. are landowners. With our own belief in the valuable energizing effects of the right of private ownership, it is not difficult to see that here a very valuable factor of safety against labor troubles does not function properly.

In any case, the growing slackness of labor and the higher cost of coal had brought Great Britain, in the years immediately preceding the World War, into a position of relative inferiority in world competition, as compared with Ger-

many. That fact explains some of the bitterness with which the war was waged. It is not true, however, that it was the cause of England's entry into the war, as is so plausibly suggested by German sympathizers.

Now that the war is over, the coal situation remains as before, while the British labor attitude seems to be distinctly worse. It is to be hoped that political wisdom will find some way for curing the disease of which this is a symptom, without at the same time destroying all the existing social structure of England. Even from a purely selfish standpoint, we are deeply interested in the result. Regarded either as a competitor or as an ally, Great Britain is by all odds the most important single factor in American life, and her political development is perhaps the thing which will best repay our attention.

The Dominions Overseas. Whatever we may think as to the future of distinctively English trade, we must realize that the doubts become much less serious when we pass from consideration of the home country to the Empire as a whole. With a steadily dwindling fuel supply, the British Isles will never again be so overwhelmingly important as they were during the nineteenth century; but on the other hand we see that in the Dominions and the colonies overseas there lie the means for renewing the ascendency of the Empire as a whole.

It is overlooked, by these who think only in terms of acreage or population, that in Canada and Australia there are very large coal supplies, very accessible for water shipment; while in South Africa and India there are large but less important deposits. Add to this the English interests, private and governmental, in the oil deposits of Persia, Burmah, Baku, Roumania and other areas, and we come to have some idea of the fuel strength, in combination, of the British Empire. Of the areas named, eastern Canada will some day become one of the great steel exporters of the world; and both South Africa and Australia seem to

have enough iron ore, in addition to their coal, to become important industrial factors in world commerce.

The Empire. Considered as a unit, the trading and manufacturing position of the British Empire has gained somewhat, rather than lost, through the occurrences of the past five years. The gain is not sufficient to restore its old world dominance in manufacturing, but it revives the shipping and trading ascendency which for a time seemed to be on the decline. It is to be noted, however that the period of oil fuel which is at hand, though it strengthens British marine leadership, brings in its train certain consequences of political type. The question of the retention of India, which once could have been discussed on the grounds of abstract justice, becomes now a matter of imperial policy, since India forms a geographical link in the vast series of oil deposits which will be for a time the most important factor in the trade supremacy of the Empire.

The Rehabilitation of Germany

In current discussions of the future of Germany, there is evident a very serious misconception of the relative importance of the different factors which give power to a nation. And there is, furthermore, a good deal of misunderstanding and erroneous statement as to the physical and territorial results of the war. In order to arrive at any fair approximation to the probabilities of the future, we will have to get a clear idea of those latter features.

Under the peace treaty, there are certain consequences as regards coal and iron ore supplies which are definite and sure; and others which are not so clearly defined, because they depend, to some extent at least, upon the later action of neighboring states. We can, however, discuss the matter with some approach to precision, thanks to the data already available as to the distribution and tonnage of coal and iron-ore reserves, presented in part in Chapters IX and XI. For our present purposes, however, some of the ma-

terial there presented must be taken up in a little more detail.

The iron ore situation. As regards the German iron-ore situation to-day, it should be needless to say that it shows a very sharp reversal from that of 1913. Before the war Germany and France had almost equal parts of the great Lorraine ore field; to-day it is entirely French, since even Luxemburg has asked admission to a French custom union. In 1914 Germany had about one-third the entire iron ore reserves of Europe; to-day she retains perhaps a tenth or less. For any future iron and steel developments she must now rely almost entirely on imported ore, chiefly from Sweden, Newfoundland or France. Such imports can doubtless be arranged, but they will increase the cost of steel manufacture to a point which, in all probability, will put Germany at a very serious disadvantage as compared with her old competitors.

There is the further possibility, which must be taken indeed as almost a probability that in future the Rhineland region may look toward France, rather than Germany, for its trade and perhaps also its political relations. There are many reasons why this would be a very natural result of the war and the peace treaty. If so, a large part of the more highly finished steel manufacture of the German Empire would be in reality French in its future trade status.

The coal situation. Germany has lost two thirds or more of her iron ore supply by the war, and she has also lost ground as regards coal, though not quite so seriously. It is with regard to coal reserve that the adjustments of the treaty are uncertain. So far as they can be stated precisely, we may say that France receives (in Lorraine) about one third of the Sarre coal field, which of course becomes an integral portion of the Republic. But she also receives, in trust for fifteen years, the remainder of the Sarre field, and since there is to be a plebiscite at the end of this period it would be a very optimist German indeed who expects

that it will again become German. The loss here amounts to some 16,000 million tons of good coal. This does not cripple Germany, but it doubles the known coal supplies of France.

On the other side, however, there is a far more serious possibility of loss, for it seems probable that the great coal fields of Silesia go to one or more of the newly created states. If that be the final result, Germany will have lost in all some 200,000 million tons, or about half her known supply of 1914. This is a very serious loss to her future manufacturing ability, and does not seem to be correctly appraised in the views now held as to rapid rehabilitation. It is true that the coal retained by Germany includes her most important producing field — that of Westphalia — but here the loss of the Lorraine iron ore operates to reduce the future value of that field.

The question of future rank. Summing up these matters, it does not seem likely that Germany will be able to regain her former competitive status, even under the most favorable assumption that there will be no separatist movement in the Rhine Provinces. Her future rank, so far as to manufacture and export of heavy steel products is concerned, will probably be third for a time to the United States and England. Even this is somewhat uncertain, for two widely different reasons. One is that in future there will probably be an era of high protective tariffs all over the world; the other arises from the fact that, under favorable conditions, the manufactures and exports of the Lorraine-Luxemburg region may attain greater importance.

The manufacture of coal tar products and of other more highly finished goods does not, however, seem to have been necessarily affected by the results of the war, and along these lines we may expect further German development. It is true that even in these products the American and English markets, always open to German goods before the war,

will now be partly or entirely shut off in order to protect the new industries which have sprung up during the war.

As to the reaction of such a restricted prosperity on the German political and social structure, there are reasons for hoping that it will not be too serious. It is true that a socialized republic has succeeded an Empire, but the Empire had gone very far along the line of paternalism, in the protection and encouragement of industries. The railroads, many coal mines, and a part of the iron ore and potash mines were government owned and operated for many years; and it is unlikely that the republic will go much further in the direction of state control. The fact that a third of the German population is still engaged in agricultural pursuits is of course a restraining influence.

The Development of France and Belgium

Apart from merely geographic considerations, there are reasons for considering France and Belgium together. Both have had the same immediate difficulties, arising from the destruction along the frontier and the consequent temporary uselessness of their old coal supplies; both share, though to unequal extents, in the re-adjustments likely to come in the Lorraine-Rhine region; and both have African colonies as very valuable assets in future trade development. It is often overlooked that France has the second largest colonial empire in the world, approximating in area to the United States. The bearing of this factor on Belgian and French revival of trade can hardly be over-estimated, and we will recur to it later in discussing the place of Africa in the world's trade.

The territorial gains made by France during the war are well understood, and the less widely appreciated gains in iron ore and coal reserves have been already noted, in discussing their loss by Germany. France now controls the cheapest iron ore supply in Europe or available for Euro-

pean use. The tonnage available is entirely out of proportion to the development of the French iron industry before the war, or indeed to the coal resources which France had then available. The former condition can be readily changed, for that is merely a matter of building new plants or extending old ones. But the coal situation is still a perplexing factor, since for four or five years the output received from the Sarre region will not be more than is required to merely replace the old output from the damaged field of Pas de Calais-Nord. The coal supply will still be the limiting factor in French industrial development, as it has been for a long time in the past.

The end result of this complex industrial situation seems to depend in large part upon the political developments, during the next year or two, in the territories along the Rhine. If these decide to enter into closer commercial and political relations with France, then the new customs union will be the inheritor of most of the old German export trade in heavy products. Otherwise, the change in control of Lorraine, though a very serious loss indeed to German trade, does not imply a corresponding gain to France, so far as industry is concerned.

So far as we can sum up the matter now, France is still likely to remain a manufacturer and exporter of highly finished goods, rather than of heavy staples. And her geographic and political destiny seems to look toward the Mediterranean and Africa, rather than toward the Atlantic. Believing, as we do, that the next great impetus to world-wide trade activity is to come from the development of Africa, this is by no means a gloomy outlook for the Republic.

The Russian States

Whatever may have been our views as to the Russian adventure, it is over now, and we can get some idea of what is likely to come of Russia when left to itself. The chief developments have been the creation of a soviet state in the

heart of European Russia, of a more or less military despotism in Siberia, and the creation of a fringe of republics along the European frontiers of the old Empire. To what extent any of these conditions are permanent is a question which no one seriously attempts to answer from the evidence, though very many absolutely cocksure answers can be obtained based solely on hopes or fears. A number of the little fragmentary governments which sprung up do not seem to be of permanent promise, though the Siberian government may take on a more permanent form, looking eastward rather than westward for its markets.

In this state of disorganization and uncertainty, the only thing that seems clear is that Russia can not become a serious factor in the world's industry for very many years to come. Her possibilities in this line were always overestimated, even under the most favorable conditions, for her coal reserves are very definitely smaller than those of England, Germany, America and other competitors. Now, with the chief coal supply in the hands of one new republic and the main trading districts in the hands of others, the chance of any great manufacturing progress seems too small to consider here.

As in the past, the various Russian states will export grain, oil, lumber, manganese ore and other raw materials; and they will import the bulk of their manufactured requirements. This condition will not be a consequence of sovietism; it is caused by having too little fuel and iron ore supplies, and having them in the wrong places. The Russian myth has been carefully inculcated, largely for political reasons, for twenty years or more, but there is no reason why the facts should not be faced now. The Russian Empire at its best had only one coal field that was worth mentioning so far as location and reserve tonnage was concerned; this was the Donetz basin. And this is estimated to contain a tonnage, not comparable to that of England or Germany, but about equal to that of Oklahoma,

or half as much as Kentucky. As for the Siberian fields, there was not the remotest possibility that they could affect the manufactures or trade of the world for the next fifty years, if then.

Given a stable and honest government, the latter of which Russia has never had, an educational system, and some reasonable approach to sobriety, Russia will at some time become a very prosperous country, but it will never become a manufacturing country of the class of England, America, Canada, China or France. Its future is more likely to be like that of Argentina, though it is possible enough that the South American republic will in the long run be the more important of the two.

The Development of Africa

When we followed out the industrial history of various countries in the early part of this book, and again when we came to study the causes of trade activity, we were brought up at intervals against the fact that world-wide periods of industrial development arise, in large part, from geographic discovery and colonial development. We saw the effects in turn of the discovery of the Americas, of the acquisition of Britain's colonial empire, of the freedom of South America, and of the westward growth of our own country. These periods of rapid extension of markets, when they followed great wars, went far toward repairing the losses of those wars, or at least toward postponing the day of payment.

Now, European rivalries in Africa went far toward causing the recent war, for since 1895 or thereabout there was a very rapid expansion of colonies all over that continent. To-day we may say, with rough accuracy, that one third of Africa belongs to France, and almost two-thirds to England.

The location of Africa with respect to Europe, the favorable climatic conditions of large regions, and the known mineral and other resources of the continent all combined

give reason to hope that in the very near future there will be a very intensive development of these resources, and a very rapid growth in the trade importance of that continent. As an inciting cause to a period of trade activity, Africa has thus great interest for us at the present day, when there seems to be ahead of us a definite slowing down in our current period of active progress. But as a future home for large aggregations of purely European type it also offers great possibilities, in two widely separated regions. Of these, South Africa has the advantage that, in future, it may become independent in the matter of coal and iron supply, since it has sufficient raw materials to be considered a possible producer, though hardly a heavy exporter of such products.

The Future of South America

It has already been noted that South America is by all means the most deficient in coal supplies of all the continents, and this fact must inevitably affect the course of its commercial evolution. Not even the occurrence of petroleum supplies will have the same effect in developing large local industries as does coal, because oil can be too readily shipped elsewhere and its cost is normally higher than that of coal when used as a manufacturing fuel.

For our present purpose, however, we may go further than this in the way of discussion, for different countries or groups of countries stand in very different relations so far as their probable future development is concerned. They will be taken up, not in order of importance, but in order of nearness to the United States.

We have, first of all, a group along the north or Caribbean coast of South America, from Colombia through Venezuela to the three Guianas. This group, aside from any other resources that it may have, has large known and probable petroleum deposits, some of which are now under development by British and American companies. This oil

will add to the wealth of the producing country only slightly, for it will not be used in any large way as local fuel. Further, there are in the same regions large deposits of iron ore, of the type which makes important the north coast of Cuba, and perhaps equally large deposits of bauxite, or aluminum ore. These ores may in time be an important resource, but they too, like the oil, will be exported in a crude state. So far as can be seen there is little hope of serious local manufactures, for the coal deposits which do occur in Colombia are not located well for becoming factors in trade.

The countries on the west coast have little prospects of becoming manufacturers until we reach Chile. Here there are coal deposits of some size, largely owned by German interests, and used among other purposes as marine fuel. The coal is not remarkably good but it will burn. It may be that some developments along manufacturing lines may be looked for, using this coal as a basis. Otherwise the only possibilities along the west coast are water power and the Peruvian oil deposits.

With Argentina we reach one of the most promising countries in the world, so far as future is concerned, but even here the chances are against very heavy manufacturing developments. The Rivadavia and other oil fields will have to become more productive, or else foreign coal will have to enter cheaper, before much can be done in the way of mills and factories for more than very local use. But the natural resources of the country are so great, and its population differs so widely from that of any other South American country, that it would be rash to say definitely that no large manufacturing industries will arise. We are facing here the development of a people of pure European types, with no negro or Indian admixture. The three elements of this population now are Spaniards, Basques and Italians. The other European influences of which we hear at intervals are not in any way serious. There are in

fact more Welshmen and Boers settled in Argentina than there are Germans, French and English together.

The two little republics adjoining are of interest because Uruguay is the soundest financial thing in South America, while Paraguay may furnish the first real test to our Monroe Doctrine. The United States may soon have to decide whether a foreign colony settled with the consent of the republic, is likely to become a menace to its future independence.

With regard to Brazil we have to deal with one of the largest countries of the world and one that is quite largely populated. But just as in the case of Argentina we will have a pure white race, so in Brazil we will apparently have the most important mestizo republic in the world. There are few inhabitants indeed who are of white blood, as that term would be used by an American. The extreme southern provinces have some chance of becoming settled by Europeans, since the climate is good and the resources great, but the war may have put an end to what seemed to be a very promising German colony. So far as fuel is concerned Brazil is practically coal-less. It has one of the largest tonnages of iron ore found anywhere in the world, however, and from time to time efforts are made to secure government subsidies for iron manufacture. Nothing of serious export importance could possibly grow out of these attempts; but there is no question but that cotton and other textile manufactures could be developed by the use of the very well-located water powers which are so abundant near the coast.

On looking back over this summary we can see that, except in a very few special cases, no country in South America is at all likely to develop serious home industries. The continent will remain largely an exporter of vegetable, animal and mineral raw materials and a good market for many lines of manufactured goods.

The Prospects of Australia

Australia, with its dependent islands acquired during the war and earlier, has excellent prospects for manufacturing development. These center about the coal deposits in New South Wales as well as those in Queensland, which together may amount to twice as much as the widely advertised coal deposits of Russia. There are also iron ore deposits of respectable though not enormous tonnage known to exist, and there seems to be no reason why the Commonwealth should not in time, aided by a protective tariff, supply itself with practically all its requirements of manufactured goods.

The necessity for a protective tariff, and a high one at that, is obvious when we consider what competition is likely to come from Asia. Further, in both Australia and New Zealand industrial conditions have been placed, by legislation, on a very high level; and free competition from laborers of other races would destroy the high average of well-being which seems to be characteristic of this very advanced member of the Empire.

On the other hand, this very high level of wages and general well-being will of itself tend to prevent Australian competition outside of the limits of the Commonwealth. The coal deposits of the region, though large enough to suffice for the needs of domestic manufacture, are not so immense as to demand exploitation for a great export trade. Further, unless all signs fail, the expansion in Australian population will, for many years to come, create a very much larger domestic market for Australian manufactured products. The country is, in fact, in these respects much in the same favorable position as was the United States during the years up to 1900 or so, when there was no serious need to consider foreign trade as an outlet for our own manufactured commodities.

The Competition of Asia

At this point we reach consideration of the factors which are likely to have by far the most serious effects on the industry of the world during the decades to come. In Europe we have been dealing largely with the past, but the new Asia is of the future.

The future reactions of Asiatic conditions on western trade and life will arise in several quite distinct ways, all which have suggested themselves at earlier stages of our study, and two of which require further consideration here. We have, to clear up the less important matters at the outset, two serious problems arising from conditions in central and western Asia. These are connected with the future industrial, political and social development of Siberia; and with the same features of the future relations of India and Persia. There is no intention of minimizing the seriousness of either of these problems, or the possibility that in the long run they may react on world affairs, but at the moment they may be treated as domestic problems of Russia and England, with which we have nothing to do. With regard to the other two matters, however, we can not drop the questions so lightly. The future course of Japanese and Chinese development are matters which concern us very immediately and very directly.

In discussing the future of the Mongolian portion of Asia, it is very difficult to avoid falling into one of the two errors which are at hand. But if we are to reach conclusions of any real value we must not accept too seriously the two widely differing theories which are so often offered as ultimate bases of thought on these subjects. The extreme internationalist will tell you, for example, that there are no serious differences in the average intellectual *ability* of different races of men, a statement which is probably true; but from this he will go on to assume that two races are likely to think and act alike, which is equally untrue. On

the other hand, the kind of man who a hundred years ago would have attributed English development to the innate superiority of the British laborer or employer, will to-day unhesitatingly pass over the question of Asiatic competition by saying that the lower races can never effectively compete with those of assumed higher type, except through sheer acceptance of a lower living standard. This, like the internationalist's views, is not entirely false, and embodies one of the half-truths which are so easy to pass off as entire truths. It is true that Oriental competition in the past has depended largely upon the existence of a lower living standard and lower labor costs; it is not true that the future danger to us lies along those lines. Low living standards and low labor costs will both disappear in the East exactly in proportion as industrialism progresses.

Further, we must keep in mind that we are not merely speaking of a vague Yellow Peril considered chiefly as a military matter. It is true that there may be war between Japan and the United States or Australia, because these three nations have individual aims which it is hard to satisfy peacefully. That war would be regrettable, but not serious. The thing that Europe, and to a lesser extent the United States, has to fear is not war, but industrial competition. This is inevitable, and it will be very serious indeed for Europe. Because, as the matter was phrased [1] some years ago, before the World War had entered to distort judgment, "When the East meets the West in final conflict, wherever and whenever that conflict may take place, it will be a case of full bunkers against exhausted ones; and no amount of courage or ingenuity will make up for deficiencies in coal supply." In an earlier chapter we have come to some idea as to how far these deficiencies exist in Europe; we may now see just what the Orient can place against them.

[1] Eckel, E. C. "Iron Ores," pages 405–406. New York, 1914.

And we shall find that the nation of which we talk most frequently in this connection is not the one whose competition will be most serious.

The status of Japan. The rapid rise of Japan in industrial and consequently in military power has caused general over-estimation of the real strength of her position, and of her probable future status as a competitor. This is brought out clearly enough when we come to take account of the natural resources upon which any large or enduring power must be based.

The known coal reserves of Japan have been estimated at some 8000 million tons. For comparison, we may note that this is a little less than is credited to Spain. It compares further with a reserve of 2,000,000 million tons in the United States, with some 200,000 million tons remaining to the German Republic; and with 190,000 millions credited to the British Isles. Though sufficient for current Japanese uses, it does not seem to justify, either in quality or quantity, any hope that it will be the basis of a very extensive export trade, either in coal itself or in heavy manufactured commodities.

This position is strengthened when we consider the iron ore resources of Japan, which are very slight indeed. The Director of the Japanese Geological Survey placed them at some 56 million tons, or somewhat less than the amount which we bring down each year from the Lake Superior district. Korea, which may be considered now as an integral part of Japan, does not add appreciably to either the coal or the iron ore reserves. Under these conditions, whatever we may think of the future development of Japan, there is obviously no chance that it can attain rank as a competitor along with Germany, England, Canada, France, South Africa or Australia.

This conclusion is strengthened by the results of the war. Financially, Japan emerged from the World War in ex-

cellent condition, being the only government, so far as known, which was actually able to *reduce* its bond issues during the conflict. But industrially and socially the position seems to be far less sound. Perhaps we can see this more clearly if we assume that at the moment Japan is in the same economic stage which Britain had reached during the Napoleonic wars. It has an over-developed industrialism, due to the fact that for years its normal competitors have been otherwise engaged. It must now find markets for a heavy over-load of commodities. Failing this, there will be extensive unemployment and social unrest. In the case of Great Britain both these conditions appeared from 1815 to 1825, but England was ultimately saved because in the long run it proved that she had the cheapest and best coal supply in Europe, so that after a temporary prostration her industries were enabled to take on renewed growth. Japan does not seem to be in this fortunate position as regards domestic supplies of raw materials. This implies that in future she must either secure ample coal and iron supplies somewhere, or find an outlet for surplus population. The first means the acquisition of Chinese territory; the second might mean difficulties with Australia and, to a lesser degree, with the United States. It is because these economic conditions are so very serious that the chances of war seem serious also. In the following chapter we may come again to this matter, in another connection. Meantime we may take up another and far more troubling phase of the Asiatic problem.

The development of China. In passing from Japan to China, we pass from a country that has experienced perhaps the maximum of its local development to one whose material bases for future growth are so vast that we may fairly expect industrial development of very remarkable extent. This development will not necessarily require cheap labor, though in its earliest phases it will have very cheap labor to aid it. But its real strength will lie in the

possession of great and easily worked coals, of very high grade.

As regards the question of tonnage, we may note that China is credited with containing high-grade coal reserves amounting to about 1,000,000 millions of tons. This quantity is about half the American tonnage; but it is five times as much as still remains to the German Republic, and six times as much as is left in the British Isles. For other comparisons, the Chinese total is one hundred and fifty times as great as that of Japan, and about eight or ten times as large as that of the Russian Empire at the time of its greatest extent. As regards grade of coal, we may further note that only high-grade coals are included in these estimates, and that almost half the Chinese tonnage is supposed to be anthracite.

A few words on the geographic distribution of the Chinese coals may serve to throw light on current political disputes. There are many coal areas in China, but the bulk of the tonnage occurs in one or two very large fields. One of these, in north China, embraces most of the province of Shansi, with portions of Chihli and Honan; and is credited with some 750,000 million tons, or three fourths of the Chinese total. The other large field, in south China, covers much of the provinces of Yunnan, Kueichou, Szechuan, with adjoining areas, and contains over 200,000 million tons.

The province of Shantung, in an isolated field contains about as much coal as all of Japan, and incidentally furnishes one of the best routes in to the great Shansi coalfield. It also yields at present about ten per cent. of the total coal output of China, which for the years immediately before the war had risen to almost twenty million tons.

During the later days of the Empire, a steel works was built at Hanyang, supposedly at government expense as a government enterprise. It seems to have passed later into foreign, nominally private, control. Its output of iron

was approximately 250,000 tons annually, somewhat greater than the total reported output of Japan. There seems to be some reason to believe that the Hanyang works could even now, if they had any surplus for export, lay down finished steel products in San Francisco more cheaply than could any American steel works.

Under these conditions as to fuel supply, and the known existing status of the Chinese labor market, there seems to be no necessity for arguing at length that Chinese competition with American and European mills would be possible. That is clear enough without discussion. The matter of real interest is not as to the fact, but as to the date of its arrival; and in this we can have little to guide us. What we do know now, however, is that industrial development can take place very rapidly indeed, if natural resources and labor are available and if capital is supplied. There is no reason to expect the growth of the Chinese steel and other industries to be very slow, provided they are undertaken at all. There would be no physical or technical obstacle, capital being supplied, that would prevent China attaining sixth or seventh place among the iron and steel producing countries of the world within ten years after the development was started; and to reach a higher rank soon after that. Building up a modern industry is very quickly done in these days, if there are the materials to work on and the money to start the work. So that if the impetus to Chinese industrial development comes, from any source, we may expect very rapid growth to follow in the steel industry. With regard to such things as the textile industries, it is probable that the growth could be even more rapid, for they do not require the extensive and relatively slow mine development that is necessary as a basis for iron and steel manufactures.

We may therefore take it for granted that the chief industrial features of the next two or three decades may easily be the growth of Chinese industrialism; and that in

the form which this growth takes, and the markets it affects, may lie the future of peace or war for the world. In so far as Chinese manufactures are marketed in China itself, and aid in the development of that country, there will be involved merely a somewhat narrower market for European and American goods. But if industries are built up in China chiefly for the export trade — and this might readily occur in an industrial development fostered or controlled from the outside, the consequences would be far more serious. In their worst form they would bear most heavily on Europe, whose coal and other raw material supplies are not excessive; but at some stage of the development American industries would feel the weight of Chinese competition.

In either case the European and American working classes will suffer from the economic pressure exerted by the new industrial nation; and as this pressure becomes more and more serious we may expect to have various solutions offered for lessening the strain. We come very naturally, therefore, to the subject of our next chapter — Industrialism and War.

CHAPTER XXVI

INDUSTRIALISM AND WAR

It has been seen, in preceding chapters, that we are likely to pass soon from our present period of very high prices into a long period during which prices and profits tend to fall off gradually, unless some new factor enters to retard or accelerate the natural tendency. Now a fall of prices, in itself, is not a necessarily serious matter, particularly if it takes place gradually, for since wages do not tend to fall quite as fast as commodity prices, the laboring classes will attain a relatively higher degree of comfort. And even a fall in the rate of profit, per ton of commodity, does not discourage capital, so long as more tons of commodity can be marketed. It is only when a fall in prices comes about because an existing market is suddenly restricted, for one reason or another, that it has a serious influence on the fortunes of all the community, because in that case the price decrease will cause unemployment and decrease in wages, while the narrowed market will cause decrease in the total profits, not merely in the profits per ton. If then we have such a narrowing of the market, we have a condition which bears heavily on all classes, and one for which all classes together will seek a remedy. It is this universality of economic motives that makes them so powerful and that gives serious importance to the subject of the present chapter.

In all of the earlier discussion, we have treated peace as being the normal state during industrial development, and war as being an unfortunate accident, not casually related to the industrial growth. That mode of treatment has certain advantages, since it frees the discussion from the danger of nationalist or racial bias, but it has also its

disadvantages and limitations. It is true that peace is always desirable for industrial development, and that under certain social and financial conditions it is practically necessary. It is true that war is always murderous, and frequently foolish; and that it always deranges the social and industrial structure of the nations that engage in it. But these truths are not absolutely universal, nor are they complete. For, given the world as it is to-day, we can not entirely dissociate industrialism from war. There are certain problems, raised by industrial development, that tend toward a military solution; there are certain reasons why, a war once arising, industrialism tends to make it more bitter and more widespread. We may profitably take up each of these subjects in turn and discuss them, not as mere abstractions, but as applied to the conditions which now exist.

Instead of commencing by consideration of the ways in which industrialism tends to bring about wars, we will arrive at more definite conclusions if we reverse the order, and note the conditions which must necessarily be fulfilled if we are to have any well-founded expectation of universal peace.

We know, at the outset, that there is at present very wide inequality in living standards in different parts of the world. We know also that there are wide differences in wealth, not between classes but between nations; and in education, using that term in a very broad sense. Now, in the present state of scientific knowledge, we can not credit these differences, to any large extent, to differences in race or in religion, two explanations which have always been easily given and accepted in earlier days. On the contrary, we have seen in earlier chapters that differences in such matters have very little real effect, one way or the other. That is to say, the effects of race and religion are not insurmountable, provided other conditions are favorable, though it would be equally untenable to say that they have no effect what-

ever. They do have some effect on both social and industrial development, but the really limiting factors seem to be of another type.

Freedom of emigration and immigration. So far as our present type of civilization is concerned, our study has made it evident enough that the most important single factor, in all the development we have studied, has been the occurrence of raw material deposits, and particularly of fuel. This conclusion of itself throws little light upon our present problem, until we add to it the fact, established also in our earlier studies, that the natural resources of the world are not entirely unlimited, and that they are very unequally distributed over the world's surface. This is specially true, again, of coal supplies. And as a corollary, we have seen that industrial development, national wealth, and general well-being have shown their greatest advances in regions and countries which are well supplied with coal; so that at present we may almost establish direct correlation between the poverty, ignorance and low living standards of any nation and its original and natural deficiency in coal supplies.

This brings us, however, to a conclusion with very serious implications indeed, for we must now admit that the inequalities in average comfort and happiness, existing between the working classes of different countries, are due almost entirely to natural and unchangeable differences in national opportunity. They can not be overcome or palliated by re-adjustment of social conditions within the backward nation itself; and the natural way to remedy them is by a flood of emigration from a country of low opportunity to one of high opportunity. That solution is so natural that it will inevitably be followed, provided neither of the countries involved places any obstacle in its course; and if the difference in opportunity offered by the two countries is really very great, the placing of any such obstacle will be looked on as a reasonable cause for war. One of the necessary conditions for universal peace, then,

is absolute freedom of emigration and immigration. It is a question whether any prosperous country really desires peace upon such terms, because of the inevitable effect upon the average well-being of its own citizens.

Freedom of trade. The second condition which is necessary, if we are to have no industrial incitement to war, is absolute freedom of trade. For it can be seen that an industrial country, with large export manufacturing capacity, can be seriously impoverished by preventing these goods from entering a natural market for them. Of course no country has any natural moral or legal right to expect that its goods will be permitted to enter freely every desirable market, but under our existing industrial system it may often come to mean something very serious to the producing country if such entry be restricted or cut off entirely. This is not an entirely new feature, for one of Great Britain's earliest wars with China was carried on solely to secure an entry for the opium produced in British India; and similar forcible opening of markets has been practised against various other uncivilized or weak countries by the more powerful industrial nations. So far no serious war has been caused by this factor, simply because in no case have the two nations involved been both of the same racial and industrial type. But in future, particularly in view of the general adoption of high tariffs which seems to be in progress, there may be increasing opportunities for trouble along this line.

Protection of national investments. A third condition of peace is that protection must be guaranteed for the citizens of any country, engaged in legitimate enterprise in a foreign country; and for the investments made externally. We know that this condition has not always been met in the past, and that many little wars and a few larger struggles have arisen on this account. With the growing necessity for important and powerful nations to seek greater portions of their raw material supplies in other

countries, and with the growing tendency to secure such supplies by direct operation instead of purchase, there will be increasing opportunities of friction. This will particularly be the case in the two or three decades immediately ahead of us, during which petroleum will be an important marine fuel for two great nations, neither of which will be able to supply itself in home territory.

The economic incentive. Historically considered, we find that most wars have originated in entirely unexpected and unimportant ways, so that the immediate dispute is over an altered dispatch, or a political murder, or some equally accidental affair. But two nations do not go to war over such matters unless at least one of them has some better reason than that for wanting the struggle. And this better reason is, in by far the majority of cases, connected with industry or trade in some important way. The underlying cause of a great war is therefor usually economic, though the immediate incentive is commonly given by some entirely un-economic incident which gives a better appeal to the passion and emotions of the populace. For it is the people, after all, which must carry on the war, and without genuine popular support no modern war could take place.

Now the great danger of economic motives for wars is that they have such a wide-spread appeal, because severe economic pressure is felt directly by the working class throughout the entire country. It is for this reason that a democratic government is even more liable than an autocracy to be carried into a war for purely economic reasons, and it is this fact which lessens the hopes of future peace. So long as our Machine Civilization endures, so long will the existing inequalities in natural resources be translated into greater inequalities in living conditions and economic opportunities, as between the countries which are naturally favored and those which are naturally limited by their resources. The real danger arises when the working people

of a country feel, rightly or wrongly, that war offers them a relief from too severe economic pressure; and when this comes to pass it will be a very remarkable government indeed which will stand out against the demand.

Wars have been brought about by economic motives in the past, and they are likely to come about for similar reasons in the future. But, even admitting this probability, we must not fall into the error of assuming that war is an economic thing of itself. The recent war is of particular interest in this connection, as affording an example of larger-scale waste than usual.

The costs of war. In discussing the amount which a war has cost to the world, it will be inadvisable to take into the account any of the merely moral or sentimental losses, for these can not be placed upon any definite basis. On the other hand we must avoid such simple modes of account as mere additions of the total expenditures of the different governments, for these do not represent in any close way the real cost of a war. Of the sums spent by any government, a large fraction represents money used for the pay and food supplies of a number of its citizens, temporarily engaged in military duty; and this is not, properly speaking, a necessary loss to the world. An additional large amount represents waste, extravagance and over-charges, for a government is rarely able to buy and use material as economically as a private concern. But the sums so wasted, though they impoverish the government as a government, are paid over to a certain class of its citizens; and though they may represent an unfair diversion of wealth, they do not destroy it utterly. Finally, of the materials bought by the government, many items are not properly chargeable as complete losses to the country or the world, for some part of them may be saved or recovered to use for productive purposes. We must therefore be careful not to over-estimate the actual costs, which as we shall see are serious enough.

In attempting to reach some definite estimate of these costs, we will assume as a basis that in July, 1914, the world had on hand a certain stock of materials, to which it was in the habit of adding at a rate which we have already determined, and for which further production it had available a certain amount of labor. Now, in November, 1918, the same world had lost or destroyed part of the original materials; it had not produced as much as usual to replace them, because a large part of its normally productive labor was in the service; and finally a very respectable fraction of this original labor supply had been killed or otherwise incapacitated for production. All these items seem to be very definite losses, which we may fairly take into account; and by proceeding in this way we will avoid the danger of being led off into a sentimental view of the case. The matter will be treated exactly as if we were operating a large business or slave plantation, and were endeavoring to take account of actual losses after four years of bad business.

In going about these estimates we will make a further limitation, for we will not consider the losses sustained by Japan or the United States, which might tend to render our assumptions and conclusions less impartial. We will therefore limit consideration to the losses sustained by the warring nations of Europe and by their dependencies, and with regard to these we will take up in turn the three sources of loss noted above.

First, there is the question of material loss. Here we must avoid over-statement, which in this particular case is a very present source of danger. Of the raw and manufactured materials bought for war use, a very large fraction indeed does not represent total loss. We can only accept as losses such materials as are completely destroyed; and these we must value at their real cost of manufacture, not at the price paid by a government. And even these values we must take at the prices of early 1914, not at the exagger-

ated prices caused by the war itself. Considered in this way, our errors will all be in the direction of minimizing the losses, for we have not enough data for coming to even approximate conclusions regarding many items. We can start, however, with the certainty that a certain shipping tonnage was destroyed; and that certain fractions of the world's output of copper, steel, lead, explosives, oil and fuel were entirely destroyed in non-productive uses.

As to shipping tonnage, we have lost a total of some fourteen million tons; and considering the class of vessels included it would be hard to value this at much less than $100 per ton. With regard to the other items there is more room for wide difference in opinion, but we may at least keep well within bounds. It seems safe to say that during the four years of war at least one third of the current world output of coal and oil; a tenth of its copper, zinc and lead; and a twentieth of its steel were used for military purposes, directly or indirectly, and were entirely wasted or unrecoverable. All the output of military explosives may also be charged off. Taking these items at the low unit cost justified by 1913–1914 business conditions, we arrive at figures about as follows:

Shipping tonnage, 14,000,000 at $100	$1,400,000,000
Copper, 800 million lbs. at $0.12	96,000,000
Lead, 800 million lbs. at $0.04	32,000,000
Zinc, 800 million lbs. at $0.05	40,000,000
Steel, 12 million tons at $25	300,000,000
Coal, 1,000 million tons at $1.50	1,500,000,000
Oil, 500 million barrels at $0.60	300,000,000
Military explosives, estimated at	2,000,000,000
	$5,668,000,000

None of these items are estimated very generously, we have entirely disregarded all other material destroyed, and we have taken no account of damage done to buildings,

railways, farm lands etc. It seems to be therefore entirely safe to place the actual material loss as certainly not less than the totals so reached; actually it was probably several times this amount, but for our present uses the lower figures will be accepted.

Second in our costs was the lost productive power, due to unproductive employment of a large mass of labor. The European countries placed, at one time or another, some fifty-five million men in the field. Of course these were not all in service at any one time, and it would probably be safest to assume that on the average the wasted productivity amounted to 1½ years per man. Now, if these men had remained on the farm or in the mill or mine, they would have produced a certain amount of material above the cost of their upkeep, in these years. It is difficult to figure this at less than $500 per year per man, considering that England, Germany and France contributed twenty-five million men of the total. But, if we accept even this low figure as a basis for our estimates, we arrive at a total loss on this account also, of some forty thousand million dollars.

We have heavily under-estimated this particular source of loss, which was in reality tremendous. That the European countries were able to carry on under such a strain was due entirely to the existence of the very large reserve of unused power existing in a modern industrial state. In an earlier chapter we have noted that one of the chief features of modern industrialism was that it had reduced the amount of labor necessary per unit of production, so that many people did no physical work at all, and the others did far less than the laborers of a century ago. During the World War all these spare or reserve powers were called into use, to fill the gaps made by the men in the line. All of the previously idle or parasitic classes found some productive work, either voluntarily or under duress. This

explains how it was possible to carry on the normal work of the nations during the war, though of course it was not an economic way of doing so under ordinary conditions.

Finally, we have the direct cost in life. During the war the European countries lost approximately ten million in killed. To these we might easily add perhaps ten per cent. of the other casualties, for in spite of all our talk about reconstruction of wounded men we must realize that a laborer or artisan who has lost his legs, or eyes, or an arm, is no longer a productive member of society, in the same way and to anything like the same extent he was before being disabled. But since this would be open to discussion we will not charge in this extra loss, but merely figure on the basis of deaths.

In doing this we are dealing with men who were Europeans, white men, mostly farm laborers and artisans, in good physical condition and young. It would be difficult to value them at less than the price of a negro field hand in 1860, particularly since all commodity prices are higher now than then. But if we do this, and assume that the men killed in Europe would have been worth $1,000 each to a plantation owner, we arrive at a loss of some ten thousand million dollars for this item.

Summing up our fractional costs in round figures we have a total result as follows:

Material losses	$ 5,000,000,000
Lost productivity	40,000,000,000
Men killed	10,000,000,000
Total war cost to Europe	$55,000,000,000

It will be recalled that, in arriving at these figures, we have looked in each case on the most favorable side of the matter, and that anyone wishing to make a showing of extreme results could have easily, and perhaps justifiably, arrived at a total double the one we present. But in any

case the situation is bad enough, and one does not have to be constitutionally averse to war to realize that it is a very expensive luxury indeed. It is the realization of this fact, by the countries of Europe, that led them to sink national pride, and abandon immediate national interest, in an attempt to grasp at any plan which seemed, for a moment, to promise that in future this horror could not recur. The countries which had not suffered so seriously, of course do not feel the matter in quite the same way as yet, and their future progress will on that account be a matter of serious interest to the world. The difference arises, not from differences in national stupidity or national selfishness, but from differences in the losses sustained. If America, for example, had suffered proportionately to England or France, there would have been some two million dead Americans left in Europe; and the arguments in favor of future peace might seem more forcible.

The future of war. We have seen, in the preceding chapter, that some of the industrial problems which will press on the civilized world in the decades immediately to come are likely to assume such shape that war will be suggested as the simplest solution. We have also seen something of what it costs the world to carry out a modern war when great industrial nations are able to bend all their energies to its prosecution. And, since there is as yet no definite hope that any mechanism for preventing war will be put in operation soon, we are forced to accept the possibility that at some time in the near future we will again face a great war of modern type. What this would mean to the social and political structure of the world does not need discussion. Merely from the standpoint of insuring the safety of our institutions we must bend all energies toward limiting the scope of any such future war. It must not be allowed to take the form of a long-continued land struggle, in the territory of an industrial country. To avoid this involves a high degree of preparedness; it also

involves protective alliances or very definite understandings tending to limit the area of possible conflict.

It is of course highly improbable that the next war will take place in such a theater, and under such conditions, as to bring about results closely like those of the recent World War; and to that extent we are barred from assuming that all of its features will be repeated in the war to come. But there were some matters of very general type to which attention may be called, as being likely to recur. Most of these arise from the fact that, under our new conceptions of war between industrial nations, we are dealing with war not between armies but between peoples. The old distinctions between civilian population and army no longer has any validity, for practically all of the civilian population — men, women and children — are engaged in raising food or making supplies for the fighting forces. It is practically certain that in any future war one or both contestants will act on the assumption that the surest way to defeat an army is to wreck the factories which supply it; and that the surest way to wreck the industrial system is to destroy its food supply. Any weapon promising to shatter the industrial structure or destroy the civilian morale is likely to be employed either openly or secretly. And as we have seen from the use of gas, the adoption of such theories and practice by one contestant will ultimately mean their adoption by the other also.

Action taking place on the land or on the water can be limited, so that adequate protection may be given the areas behind the lines. But action under the water and in the air can not be guarded against so effectively, and in the plane and the submarine we have found powerful offensive agents which can under any ordinary circumstances penetrate at will any guarding cordon or blockade. In any future war all parts of the warring countries may become theaters of enemy action; and all elements of the populations will share in the dangers and losses.

CHAPTER XXVII

THE FORMS OF FUTURE PROGRESS

We have managed to come thus far, in tracing the course of modern industrialism from its inception to the present day, without calling into service any preconceived theory as to the underlying causes which have determined the trend of that remarkable evolution. Even with regard to the social and political changes which have accompanied our industrial progress, there has been little stress laid upon any assumed necessity for development in any certain direction, under the influence of overpowering natural or supernatural forces. The facts have merely been noted as they came to light, and accepted as facts, without attempt to force them into use as supports for any pre-conceived theory of the world, or of social progress, or of the state.

With our later chapters, however, we have finally come onto ground where something more than this must be attempted, if we are to arrive at any conclusions regarding the future trend of development in any of these lines. For we have seen that, even for the nearer future, there are apparently antagonistic tendencies, within our industrialism itself, in relation to a matter of so much world importance as the question of war.

If we pre-judge these questions, by assuming that the human race is being driven in a definitely determined direction, under the influence of omnipotent forces, it is of course easy enough to arrive at a perfectly definite and assured conclusion in regard to any one of them. For in that case we have merely assumed a basal principle which, once admitted, must lead directly in each case to one certain conclusion. The conclusion will, of course, vary neces-

sarily according to the theory adopted; the believer in direct divine control will necessarily arrive at one result; the believer in purely natural physical evolution at another diametrically opposed. But either basis once accepted, ordinary logic brings one inevitably to a pre-destined conclusion.

When we turn from this most general phase of the matter to such more special phases as the mode in which our progress takes form, we meet with the same difficulties. For even here, the original choice of some special method of action brings with it always corresponding and necessary conclusions. If we assume, for example, that political progress is a function of increasing democracy, we arrive necessarily at widely different ideas as to necessary action and results from those which we would have to reach if we started from some other equally possible principle. And so, to an even greater extent, with the lesser theories, affecting industrial and social growth in narrower ways. A theory of life, or of the world, or of the state carries with it the necessity for judging all things as they happen to appear from the standpoint of that theory, and of assuming that all future changes must take place along the lines which will give greatest effect to the forces which we have accepted as omnipotent.

The futility of such methods of attacking the problem of progress is evident enough, yet nevertheless much of the literature of industrial and social development is based upon them. Whether we deal with a book on social evolution, cadging for the support of religious sectarians, or one on natural political evolution, explaining the justice and necessity of German aggression on Belgium, or one on syndicalism, pointing out the class-uplift to be derived from sabotage, we are dealing in each case with a study starting from pre-conceived theory and of necessity arriving at predestined conclusions.

It is very difficult to keep entirely free from the unin-

tentional and unobserved bias due to class, race and national prejudice, not to speak of religious influences; but we may attempt to outline, merely as a record of accomplished fact, the course of development that has taken place since modern industrialism arrived on the scene. In doing this we will attempt also to avoid judging any of the matters involved, so far as their moral bearing is concerned. To do that would be to fall back into the error which has just been discussed, because it would imply that we start by accepting some definite natural or supernatural sanction as a warrant for our judgments.

Increased material wealth. Taken up in this way, we can see that there stand out from the less important things two main changes, on which it seems as if we could all agree; and a third, whose origin and effects are less clear and on which there is more room for difference of opinion. The first great change in conditions since the time of the Industrial Revolution in England seems to have occurred, and to the same extent, in all of the modern industrial nations, so that we can look upon it as being caused by some very broadly acting force, and not by local or special influences. It is, that there has been a very great increase in the production of material wealth, as expressed in commodities; and that this increase has been, for the first time in human history, at a rate faster than that of increase of population, so that there has been also a very striking increase in wealth per capita. This condition is, it must be repeated, one absolutely new in the history of the world, and it is thanks to the steam-engine and the machine tool that it has been brought about. It can be seen readily that it is largely independent of any changes in form of government, or in political or religious ideas.

Now, if increased production of wealth were entirely independent of modes of government and of tendencies of thought, we could dismiss it from further consideration. For in that case the force of the machine civilization would,

acting of itself, tend toward greater and greater production of commodities up to the point that we encountered natural obstacles to further increase, such as exhaustion of raw material supplies; and we have already seen that such exhaustion, for our really important resources, must be set at a date very far off indeed.

Actually, however, our machine civilization will not function of itself, but needs definite and continued human effort to keep it in motion. This is applied in the labor, both mental and physical, required to carry on existing processes; and in the labor, almost entirely mental, required to improve them so as to ensure further progress. For in the last analysis our increased output of goods means simply increased control, by man, over natural forces and conditions. We therefore come to see that any change in political, social, or religious ideas which makes for lessened production, or for stagnation in technical progress, affects very directly this first great gain of modern industrialism. That is the real underlying objection to syndicalism on the one hand and to monopoly on the other; for both tend to reduce output and prevent technical progress.

Higher living standard. If the increased material wealth, produced as has been noted, could possibly remain massed in the hands of those who had produced it, the mere fact of the increase could have no beneficial influences on social conditions in general. And it is well to note, a fact commonly overlooked, that this would be the case, regardless of whether the new wealth went into the hands of the capitalist, or of the laborers directly interested in its production. Under the latter condition the new wealth would be distributed a little more widely, but it would have no broad results on the well-being of the community in general.

Fortunately, however, along with our great gains in output of commodities, there have been also great advances in the average living standard, due to the more equal dis-

tribution of the goods produced. There can be little room for doubt as to the facts of the case, and probably everyone really believes what has just been said, though of course radical thinkers do not call attention to this condition. In reality there seems to have been a pretty steady and very large increase in the comfort, food supply safety and general well-being of everyone in the modern community, as compared with the conditions which existed one hundred or even fifty years ago. Working hours are shorter for everyone, there is more food available per capita, there is more clothing available for each person, and above all there is far greater safety and community-comfort about life now than was possible, even in England, a century ago. All of these things are purely and simply matters of fact, which can be tested by actual statistics. There has been very definite and general progress along this line; and it will not do to simply pass that by and say that under some other dispensation there might have been more progress.

At this point we might note that, during the recent war, we have passed through a time when there was a destruction of wealth, along with a destruction of men; and in such quantity that there is for the moment a poorer world, on the average, than before the war. This condition can not be righted until production everywhere reaches its old levels.

The growth of democracy. The great increase in material wealth was due entirely to the action of modern industrialism, and the more equal distribution of such wealth has been also effected, in part, by the changes in industrial conditions. But there has been a third factor at work to bring about the conditions which we find to-day. This factor, of far greater antiquity than the others so far as its beginnings are concerned, has however only come into full play during the modern industrial period. It is the approach to equality in political rights, as expressed by the gradual growth of political democracy.

In our own country and in England the spread of democratic control has been so continuous that, taking it into consideration along with the disappearance of serfdom and of slavery, the general tendency has been to think of the progress of the world as having for its main feature the attainment of individual human freedom. Some of the political schools have considered such freedom as the cause of progress; others have treated freedom as the effect of progress. But the fact that some general correlation between the two phenomena is accepted by most writers should not blind us to the fact that there are two very important schools of thought which tend, explicitly or implicitly, in an entirely other direction. Neither the rigorously scientific application of natural evolution, nor the otherwise optimistic anticipations of the socialists, lead us in the direction of further democracy. Both in fact, whether admittedly or not, tend rather in the direction of a very strong and permanent control of political and social action; and of the creation in each case of a definitely governing class, as distinct from the governed mass. Whether this class is to be the intellectual elite, as anticipated by the evolutionist; or a bureaucracy of functionaries, as will be developed from a continuous socialist control, does not in any way alter the conclusion that in neither case will there be a democracy. We have, therefore, the possibility of reactions against the democratic trend, from two different directions; and we may expect that in countries where conditions are favorable to these new doctrines there may be development along lines which we would not regard as normal for England or America. For this reason we can not regard democracy as being so absolutely universal a form of government as it is sometimes considered; we can merely regard it as being the form which seems to be best fitted to our own conditions and inherited ideas.

The equalization of opportunity. If we accept democracy as a guiding principle for the political evolution of

our own country and of countries of similar historic type, we must accept immediately certain of its implications. There will of course be opportunity for education offered to all the citizens of a democratic country, for the universal adult suffrage toward which our democracies tend can not be safely or intelligently exercised by an ignorant mass. And, equally obviously, there must be a growing tendency toward equalization of opportunity in other lines, industrial and social, for having once given political power to all classes alike, there will be a very natural advance toward equality in other lines.

We need not admit that all men are equal — mentally, morally or physically — for that is demonstrably untrue; and all the political practice based on such a theory has always come to wreck, down to our own experiences after 1865. But it can be fairly urged that, accepting natural inequalities, these should not be interfered with by artificial regulation or classification. Given a mass of men of naturally unequal ability, their individual betterment should be limited only by these original inequalities. And, as has been clearly stated by one [1] of the few scientists whose applications of evolutional ideas have led to anything definite in sociology, education is the one factor, in such betterment and equalization of opportunity, that is entirely within our control. The fact that much of the so-called education offered in the past has produced little positive result is not an argument against its future value, and we have seen the very direct and important part it plays in such immediately practical matters as the progress of invention and discovery.

The strength of nationalism. The development, industrial, social and political, of any community is based upon the action of three main factors, all of which must be taken into consideration when we discuss the trend of its future growth. Two of these factors affect alike plants, animals,

[1] Ward, Lester F. "Dynamic Society," New York, 1883; "Applied Sociology," New York, 1906.

men and nations; while one is peculiar to human beings and human communities. There is always danger that, in considering social evolution, we will play too much stress upon one particular factor, and overlook or minimize the others.

These three factors are the effects of the inheritance, of the physical environment, and of intentional effort. Of these the two first are practically out of human control so far as any given generation at least is concerned; but the third is not so entirely uncontrollable. For this reason, since it is the one which must be brought into play in order to effect any immediate change, it is the one on which reformers of all sorts necessarily lay greatest stress. Meantime the other factors exist, and serve to modify or limit the results of intentional human action, so that often times the final results are far from what had been anticipated. To have this disparity brought home we need only contrast the hopes of the French Revolution in 1789 with its practice in 1793; or the dreams of the abolitionists with the practice of reconstruction. In both cases reforms which in themselves were entirely justifiable led to results which were equally deplorable. As for the action of the physical environment, we have had ample evidences of its great effects, during the period of modern industrialism, when we studied the course of events in the great coal-holding countries.

The general effect of the combined action of all three factors, during the past century, seems to have been a large development of the spirit of nationalism, in such countries as possessed any essential unity of race or of history. When, in such cases, there has been also great increase in national wealth, due to industrialism, along with any fair approach to equality in political rights and equalization of opportunity, the traditional and environmental factors have been together strong enough to overcome any purely intellectual tendencies towards either socialism within the state or internationalism without.

On the other hand, in countries lacking in essential unity or in equality, there have been separatist tendencies created, along racial or class lines; and in both cases there has been a tendency toward international rather than national forms of aspiration. Both racial and class ambitions and antagonisms were widely preached in the two decades preceding the World War, and in both cases the events of the war gave these schools the greatest possible opportunity for development. It is unlikely that conditions will be as favorable in future, and we may fairly expect that both lines of endeavor will reach their maximum of expansion and of influence very shortly, if indeed they have not already passed that maximum.

In our own country, and in most of those in which we are deeply interested, underlying conditions seem to point toward strengthening, rather than weakening of nationalist ideas and practice. The United States, France and England are not likely to split up along class or racial lines of cleavage. They are all likely, on the other hand, to develop along more strongly national lines, and to practice greater government control just in order to remove some of the opportunities for such cleavage. The changes necessary in these respects will depend in large part on the existing conditions, as to equalization of opportunity; and in these respects some of the countries named are in better shape than others. A high per centage of land-owning population and further increases in material production aid in stability; over-concentration of land ownership or restriction of future industrialism would, on the other hand, make for further political re-adjustments.

The future of internationalism. From internationalism, as the main aim of our development, we may differ very sharply, as tending to lead in directions which would retard rather than aid that development. And this is true of either of its forms, for neither syndicalism nor unqualified

pacifism can be accepted as a guiding principle for any nation. At the moment, taking account of the losses of the war, the urgent necessity is for the greatest possible efficiency in production, in order to make up these losses; and this maximum of efficiency seems most likely to be attained by competition within the nation and between the nations. A strong nation, with such political mechanism and practice as will most reduce internal strife, seems to be the direction which future development will take, and in the long run it offers perhaps the best basis for any rational hope of future world peace.

With development of a strong and independent national consciousness, however, there must in time come the beginnings of a real international consciousness. We have seen, in the course of our study of the growth of industrialism in general and of foreign trade in particular, that it is folly to think that a great industrial nation can now isolate itself from world affairs. The attempt to do so merely postpones an inevitable day of reckoning. And in view of the tremendous material losses which we have seen were sustained by the world during the recent struggle, every sane man realizes that another war of that type, within the lifetime of the present generation, would wreck the industrial, social and political structure of all the civilized world. Our margin of safety, as against famine and crime, is as yet too small to permit indulgence in such expensive pastimes. Merely from a selfish standpoint, we must arrive at some better method than war for settling international disputes and differences. So far as past development throws any light on the future, the final solution here is likely to come about, not through the formation of an international state, but through the coöperation of strong national units, each freely developing along its individual line.

A group of such units, with economic interests not too

widely opposed, and acting together under express or implied alliance, could even to-day go far toward preventing some wars and limiting the scope of all others.

The obstacles to peace. The objections to an effective league of nations are to a large extent selfish and perhaps transitory; but the obstacles in the way of permanent peace, under our present type of civilization, are very serious indeed and perhaps insurmountable. The seriousness of the matter arises from the facts that the chief incentives to future war, which we see even now exposed, are economic and industrial; that they involve the great industrial nations; and that democracies are peculiarly liable to undertake war as a relief from economic pressure. Incentives of this dangerous type are afforded by the desire of soviet Russia to spread its economic doctrine; by the desires of Great Britain and the United States to control the fuel oil supplies of the Caspian and Caribbean areas respectively; by the desire of Japan to secure a continental area for expansion; and by the high probability that China will develop her industrial resources. Each of these conditions comes to pass as the result of a thoroughly natural evolution, and violent assertion of each of the assumed necessities is probable enough under our current standard of international morality. When, as in most of these cases, there are also vast differences in race and religion between the nations which will be involved, the hope of permanent peaceful solutions within the two or three decades ahead seems slight indeed.

The trend of industrial evolution. Meantime, within the structure of industry itself, we see that there are certain tendencies which in the long run may bring about vast changes in international relations. For one hundred and fifty years the world has been engaged in the intensive material development which has culminated in our present Machine Civilization. There is no reason to believe that this development is nearing its end, but even before the war

there seemed to be indications that the machine was slowing down perceptibly, and that a change in trend of future development was impending. The decade ending with 1920 will almost certainly show, for such important factors as world population, coal output and steel output, the smallest rate of increase that any decade has shown for over a hundred years. And this decrease in rate of growth will not be due entirely to the World War, because it was in progress even before the war.

Further than this, we have seen that though our coal and iron resources are not nearing exhaustion, we have probably passed the point of maximum cheapness for each of the raw materials and for its products. In future they will be scarcer and dearer, as compared with other and newer resources. And with this will come about changes in the relative importance of producing districts and of the power of nations. The relatively brief period, perhaps only thirty or forty years, during which petroleum will be of serious industrial importance will not affect these conclusions to any large degree.

Finally, partly as the result of the fiscal necessities of the nations, we seem likely to witness an intensified nationalism everywhere, and this will be expressed in its industrial relations by high tariffs and by attempts to make the respective nations self-supplied. This implies, however, some degree of decentralization of industries, as compared with their present localization in a few countries; and it implies also a lessening importance of transport as compared with manufacture. In place of using a third of our coal merely to carry goods up and down the earth, we will be able to use this fuel in more directly economic ways.

All of these factors work together toward lessening the pressure upon our coal and iron ore resources; toward readjustments of the balance of power between localities and between nations; and toward throwing the trend of our future development into other lines than those which have

been heretofore preëminent. The capital and labor which would formerly have been employed in transport and the cruder manufactures will in future be free to take up other lines of activity. As to the direction of such activity, we can only suggest that the trend of future development is likely to be along chemical rather than mechanical lines.

In areas favored by abundant natural resources, and protected by strong industrial and military power, future industrial growth will tend to lessen class friction, rather than to increase it. But the fact that France, Britain and America, under such conditions, are likely to develop politically as pure democracies, with a large measure of individual freedom and activity, should not blind us to the fact that there are other nations, not so favored, whose development may take other courses. It is questionable, for example, if the reaction from a broken-down autocracy in Russia, Germany or Japan will result in a government democratic in form, for in each case there are natural or artificial limitations, at present, on the economic possibilities of these nations; and these limitations tend to lower the average of well-being, and to increase class friction. We are likely, then, in the future to face wide differences in political ideas as well as in prosperity, between the members of two powerful groups of nations.

In the end, then, we come back to the fact that there are very serious material difficulties in the way of future peace. These difficulties are of natural origin, being ultimately dependent upon the unequal distribution of important natural resources. They may act directly, as in the case of the coal of Westphalia and China, the iron of Lorraine, the oil of the Caspian and Caribbean — all of which may serve as immediate causes of war or as the bases for that competition which is in the end more crushing and deadly than war. Or they may act through their effects upon political development, so as to create the possibility of international conflicts.

INDEX

Africa, coal resources, 108, 112–113, 334; European rivalries in, 334; future development, 334, 335; iron ores, 335
Africa, South, coal resources, 107, 112, 115, 327, 335; economic development, 335; gold output, 151; iron, 327
Air transport, 209, 218
Alabama iron ores, 57
Aluminum, 67, 155–157, 161–164, 175–176
America, North, coal resources, 108, 112–113; development of, 17–47; iron production, 32–33; petroleum reserves, 127–128; trade with Great Britain, 22–23; *see also United States of America*
America, South, aluminum ore, 336; coal resources, 108, 112, 115, 326–328; economic future, 335–336; iron ores, 336; petroleum, 129, 336–337; quicksilver mines, 172
Analine dyes, *see Coal Tar products*
Animal products, 214, 227
Anthracite coal, *see Coal*
Arbitration, 251
Argentan, 173
Argentina, economic future, 336; population, 336–337
Asia, awakening in, 68–69; coal resources, 108, 112–114, 343–344; economic future, 339–345; economic menace, 71; industrial history, 68–73; iron ores, 343–344; misinformation regarding, 69–70; petroleum supplies, 130
Australia, coal resources, 108, 112, 115, 338; economic future, 338; gold discoveries, 145; iron ores, 338
Austria-Hungary, coal resources, 114

Bauxite, 162, 163, 336; *see also aluminum*
Belgium, child labor in, 247; coal resources, 114; industrial development, 331–332; industrial disaster in, 78–79; invasion of, 78–79
Bolivia, tin production of, 170
Brazil, economic future, 337; iron ore supplies, 140, 337; manufacturing in, 133; water power, 337
British-American trade balance, 23
British Empire, future trade relations of, 325–328; *see also Great Britain*
Building stone, 182

California, gold in, 14, 38, 143–144, 240
Canada, coal resources, 113, 327; economic future, 327; iron ore supplies, 327; nickel supplies, 174
Canals, 207, 218
Capital and Labor, 244–245, 303–304; conflict between, 244–245
Caribbean oil fields, 129
Caspian oil fields, 130
Cement, 182, 211–212, 218
Charcoal, 39
Chemical industries, 216–217, 219
Chemical materials, 177–182
Child labor, 247, 275
Chile, coal resources, 115; economic future, 336; nitrate deposits, 179
China, coal resources, 113–114, 343–344; competition of, 343–345; economic future, 342–345; iron and steel, 343–344; nickel in, 173
Civilization, bases of, 93–98; machine, 94–95, 202, 244–245, 350, 361, 368
Class rule, 302–304
Clay products, 182
Clothing and textiles, 212–214, 219
Coal, anthracite, 33, 108; as raw material, 101–103; bituminous, 33, 79–81, 108; character and costs of, 110–111; distribution of, 106–107, 112–115; exhaustion of, 109–110; export of, 104–106; importance of, 95–96; lignite, 108, 110; power in 1914, 80; resources of world, 99–116; state ownership of mines, 98; uses of, 99–101, 103–104; world output of, 313; world resources, 108–110, 112; *see also under individual countries*
Coal oil, 102; *also see petroleum*
Coal Tar products, 102–103, 219
Coke, 39, 101–103, 219
Cold storage, 210, 218
Colombia, coal resources, 115, 336; economic future, 335–336; petroleum deposits, 129
Combinations, 46, 235–236, 264–266;

advantages of, 267–269; causes of, 264–266
Competition, African, 334–335; Asiatic, 70–73, 339–340; Australian, 338; British, 325–328; Chinese, 343–345; factors of, 317–324; French, 331–332; future of, 325–345; German, 328–331; Japanese, 341–342; Russian, 332–334; South American, 335–337
Copper, 158–161, 176; distribution of, 158–160; supplies of, 155–157
Corporations, development of, 253–269; corporation Act, N. J., 279
Cotton, 212–213; output compared with iron, 214; spinning and weaving of, 219
Crises, financial, cause of, 233–236
Cuba, iron ore, 140, 336

Debt after war, 286
Democracy, growth of, 362–364
Donetz coal basin, 333
Dumping, practice of, 320–321
Dyes, coal tar, *see coal tar products*

Electrical inventions, 205–206, 218
Electric power, 133–134, 205, 218
Emigration and immigration, 348–349
England, *see Great Britain*
Europe, coal resources, 108, 112, 114–115; iron ore supplies, 137, 140
Exchange, foreign, 323–324
Export trade, 321–323

Fertilizers, 179, 181–182, 211
Finance and war, 83
Food supply, 199, 210, 218
France, aluminum ore, 67, 162; coal output, 63–66; coal resources, 114, 332; colonial empire, 62, 331–332; economic future, 85, 331–332; effect of World War, 317; free trade treaty, 66; industrial history, 61–67; iron ores, 140, 332; output of, 43, 64–67; manufactures, 61, 63, 66–67; patent system in, 222; phosphate output, 182; territorial gains, 332; textiles, 64–65, 67
Free trade, 13, 275

Gas engine, 203, 218
Gas, acetylene, 219; illuminating, 100, 102, 218; natural, 131
Gasoline, 122–123
Germany, agriculture in, 331; coal resources, 107, 114, 329–330; coal production, 51; coal tar products, 102–103, 330; economic future, 85, 328–331; government regulation in, 276–278; industrial development, 48–60; internal improvements, 52; iron ores, 60, 329; iron production, 43, 52–53, 59–60; patent system, 222; population growth, 50, 195; potash deposits, 181; rehabilitation of, 328–331; state railway system, 52
Gold, abundance of, 157; American treasures of, 143–144; Australian supplies of, 145; discoveries of, 38, 142–147; future supply of, 150–152; industrial effects of, 144–150; older supplies of, 142–143; output of, 148, 155–157; prices of, 147–150; Russian, 149; South African, 143, 151
Government, debts, 286
Great Britain, agriculture, 326; coal resources, 107–108, 114; economic future, 325–328; effect of World War in, 317; gold supplies, 14; government policies in, 274–276; industrial future of, 325–328; industrial history of, 3–16; industrial leadership of, 13–15; industrial revolution in, 10–13; iron ores, 140; iron output, 3–4, 7–9, 11, 16, 43; labor conditions in, 326–327; markets, 9–10; overseas dominions, 10, 327; patent system, 222; petroleum supplies, 327; textile industries, 5–6; transportation, 6; wheat prices, 237; world leadership of, 13–15
Guianas, the, 335

Higher living standard, 361–362
Holland, coal resources, 114
Housing, 210, 218
Hungary, nickel supplies in, 173

Imperialism, 75
India, coal resources, 114, 327; importance of to Great Britain, 328
Individualism, passing of, 290–292
Industrialism, and war, 85–86, 346–357; beginnings of, 5–7; causes and effects of, 87–89; effects on laboring classes, 244–247; evolution of, 368–370; following World War, 285–286, 317; future of, 89, 283, *et seq.*; growth of, 305–316; legislative helps and hindrances to, 270–280; *see also under individual countries*
Industrial evolution, factors of, 187–

200, 253–262; future of, 358, *et seq.;* trend of, 368–370
Industrial revolution, beginning of, 87, 93, 296; in America, 30–39, 87; in England, 10–13, 30, 87
Integration of industries, 255, 259; advantages of 259–260; legal status of, 261–262
Internationalism, failure of, 74–75; future of, 366–367
Internationalist theories, 340
Inventions, incitement to, 220–224; effect of monopoly on, 223; under socialism, 223
Invention and discovery, progress of, 201–224; shown in chronological table, 218–219
Iron, abundance of, 157; importance of, 80–81, 95–96; output of, 214, 157, 313; price history, 215–216; technical progress, 214–216; trade in American colonies, 17–21; *see also individual countries*
Iron ores, annual production, U. S., 44; great region of, 139–140; importance of, 136; of Loraine, 56–57, 60, 66, 331–332; state ownership of, 98; summary of facts, 140–141; total reserves of, 136–138; unequal distribution of, 97; world resources of, 135–140, 157; *see also individual countries*
Italy, aluminum supplies, 162; pyrite supplies in, 179; quicksilver supplies in, 172

Japan, coal resources of, 114, 341; copper output, 159; economic future of, 86, 341–343; effect of World War upon, 317, 342; industrial history, 71–73; iron ores, 342; modernization of, 72–73; raw materials in, 342; social conditions in, 342

Korea, 342

Labor, and Capital, *see Capital and Labor;* conditions, 245–248; unions, 249–252; unrest, 248–249
Lake Superior iron ores, 42, 140
Lead, 164–166, 176; commercial uses of, 165; price history, 165; world output of, 164–165; world resources of, 154–157
Leather, chrome tanning of, 218; price of, 228
Lignite, 108, 110
Lime, 180
Linen, 63
Loraine iron ores, 56–57, 60, 66, 140, 331–332

Machine tools, 96, 204
Machine civilization, *see civilization, machine*
Machinery, absence of, 25; effect on civilization, 94–96, 201, *et seq.;* progress of, 218–219
Malay States, tin deposits of, 170
Manufactures, increased consumption of, 196–197
Markets, expansion of, 106, 190–191, 197–198; accessory and limiting factors, 198–199
Mergers, *see combinations*
Mercury, supplies, *see quicksilver*
Metals, abundance of, 157–158; commercial, 153–176; output of, 155–156; precious, 142–152; *also see separate headings*
Mexico, petroleum supplies, 119, 125, 129
Militarism, 75
Minority leadership, 300–301
Monopoly, effect of, 223; control of, 250–251
Motor transport, 208, 218–219

Nationalism, 273; in World War, 76–77; strength of, 364–366
Nations, struggle of, 74–86
New Caledonia, nickel output of, 173–175
Newfoundland, coal supply, 113; iron ores in, 140
New South Wales, coal deposits in, 115, 338
New Zealand, economic conditions in, 338
Nickel, 155–156, 173–176
Nitrate supplies, 179
Northern Securities Case, 279–280
Norway, nickel supplies of, 173; pyrite, 179

Oil, *see petroleum*
Open hearth process, *see steel*
Opportunity, equalization of, 363–366

Paraguay, 337
Patent systems, 222
Peace, conditions of, 347–350; obstacles to, 368–370
Persia, petroleum deposits in, 130
Peru, petroleum in, 119
Petroleum, British control of, 130; discovery of, 117; industry, growth of, 117–131; industry, future of,

128–130; products of, 122; resources, U. S., 128; sources of, 126–130; statistics of, 117–131; supplies of, 120–122; utilization of, 123
Phosphates, supplies of, 181–182
Political beliefs, progress of, 288–304
Population, effect on industry, 188–193, 307–310; growth of, 193–196, 305–308; world, 194–196, 305–309
Potash, supplies of, 181
Power, developments, 218; mechanical increase of, 201–208
Precious metals, supply of, 142–152
Prices, affected by demand and supply, 225–229; affected by gold output, 145–150; average levels of, 231; booms and depressions, 232–233; changes in, 225–243; general course of, 230–239; high, effects of, 241–242; low, effects of, 242–243; war's effect upon, 238–239, 315–316
Protection, 15, 278
Protective tariffs, 35, 37–38, 41, 64, 338
Pyrites, supplies of, 178–179

Queensland, 338
Quicksilver, 155–156, 171–173

Railroads, 204, 208–209, 218
Refrigeration, 211, 218
Regulation, growth of, 294–297
Rumania, oil deposits, 327; oil shipments, 118
Russia, coal resources, 114, 333; economic future of, 332–334; exports, future, 333; iron ores, 333; petroleum in, 119

Salt, 180
Sarre coal field, 60, 65, 329, 331
Scandinavia, iron ores, 140
Sherman Act, 279
Siberia, coal resources, 114; gold output, 13, 149
Silver, 145, 152, 155–157
Socialism, program of, 292–294
Spain, coal resources in, 114; iron ores in, 140; lead output, 164; pyrites in, 178–179; quicksilver deposits, 171
Spelter, *see zinc*
State regulation, 294–297
Steam engine, 6, 12, 199, 203–205, 218
Steamships, 36, 204, 218
Steam turbine, 203, 206
Steel, and machinery, 219; annual production in U. S., 42, 44; basic Bessemer, 60, 219; Bessemer, 14, 42, 58–60, 219; blister, 30; crucible, 39, 219; integration of American industry. 255–258; open hearth, 42, 219; power in 1914, 79; Siemans-Martin, 42; Thomas-Gilchrist, 58–59, 222
Stone supplies, 182–183
Strikes, 250
Structural materials, 182–183
Submarines, 219
Sulphur, supplies of, 178–179
Sulphuric acid, 217
Syndicalism, 75, 293; in Russia, 84–85

Tariffs, 35, 37, 41, 338
Telegraph, 209, 218
Textiles, 63, 212–214, 219
Tin, 155–156, 168–171, 176
Trade, Asiatic, 66; colonial, iron, 17–21; conditions after war, 285–286; cycles of, 249; depression, 34; expansion, 324; export, 321–323; foreign, rise of, 318–320
Trades unions, 249–251
Transportation, ancient and modern, 206–210; progress of, 209, 218; in England, 6, 12
Trusts, *see combinations*
Turbine, steam, 203, 209, 218; water, 218

United States of America, agricultural production, 46–47; coal output, 33–34; coal resources, 113; early manufactures, 25–27; exports, 46–47; gold discovery in, 38; gold output, 149; government regulation in, 278–280; industrial history, 17–47; industrial revolution, 31–40; iron exports, 47; iron ore supplies, 15, 17–18, 29, 39–40, 42, 140; iron production, 20, 31–33, 44; iron trade 17–22, 36–39; manufactures, 46–47; cil industry, 130–131; patent system, 222; petroleum reserves, 127–128; phosphate production, 182; political corruption in, 45; population, 194–195; steel industry, 42–43, 257; tariffs, 35, 37, 41; trusts, 46; wars, effect of in, 40–42; world leadership, 43–46
Uruguay, 337
Vegetable products, 214, 228
Venezuela, petroleum in, 129
Victorian Age, 74

Wages, 248–249
War, costs of, 351–355; economic in-

centives to, 350–351; effect upon industry, 48, 49, 55, 78–85; future of, 356–357; industrial factors affecting, 356–357
Water power, 132–133
Wealth, ancient concentration of, 143; material, 360–361
Westphalia coal, 64
Wheat, prices of British, 237
"White Man's Burden," 68–69
Wool, 213–214
World War, 74–85; industrial factors affecting, 77–82; industrial and political consequences of, 85–86; lack of prevision in, 83–84.

"Yellow Peril," 70–71, 340

Zinc, 155–157, 166–168, 176